INTERDISCIPLINARY APPROACH TO CURRICULA DEVELOPMENT IN GEOMATICS EDUCATION: ERASMUS+ LBS2ITS PROJECT

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ABSTRACT:

LBS2ITS is a Curricula Enrichment delivered through the Application of Location Based Services to the Intelligent Transport Systems project funded by the Erasmus+ programme. The main goal of the LBS2ITS project is the development of the new and the modernisation of the existing curricula in four Sri Lankan universities. The project takes an interdisciplinary approach and is currently developing curricula on topics of Location Based Services and Intelligent Transportation Systems from the perspective of disciplines such as geomatics, cartography, transport engineering, urban planning, environmental engineering and computer science. In the paper, we detail our approach to curricula modernisation and development in two phases: teacher training and development. We also provide more details and theoretical backgrounds for the methodologies such as Problem Based Learning, Problem Based e-Learning, and Quality Aassurance in teaching.

1. INTRODUCTION

Curricula Enrichment delivered through the Application of Location Based Services to Intelligent Transport Systems is an Erasmus+ Capacity Building in Higher Education project delivered for four Sri Lankan universities (abbreviated — LBS2ITS). The key action of the project is cooperation for the purpose of innovation and the exchange of good practices in higher education of geomatics, transport engineering, urban planning and computer science. The project activities started in 2021 and will continue until the end of 2024.

At the time of writing the proposal in 2019/2020, Sri Lanka stood in the middle-income category. The country was focusing on long-term strategic and structural development challenges for the transition to an upper-middle income country. This has changed firstly due to Covid-19 and secondly due to the worst economic and political crisis in 70 years that started in April 2022. During the last decade, the immediate priority of national physical development has raised pressing mobility issues in the western region of Sri Lanka (27% of the SL population and >50% of GDP). In response to these issues the “The National Physical Planning Policy and the Plan 2050, 2018”, expedites actions aligned into four ‘development corridors’, which aim to connect all seaports and airports by expressways and improved high-speed railway links to serve at least 60% of the country’s population. Consequently, efficient, affordable and reliable transportation along these corridors has been identified as a national priority.

These goals are even more important now when Sri Lanka faced, in addition to food and medicine shortages, fuel shortages that immobilised the country. To ensure a sustainable transport system and mobility, good Intelligent Transport System (ITS) and Location Based Services (LBS) are necessary. More than ever, good engineers with up-to-date knowledge and experience working on good technology are crucial in Sri Lanka’s recovery and development to previous goals. This is also in line with the “National Physical Development Policy and the Plan 2050, 2018” of Sri Lanka, which is to “update the workforce of the country by disseminating knowledge to maintain the ongoing developments to the state-of-the-art smart transportation standards as practised by developed and well-organised cities”.

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The LBS2ITS project focuses on regional cooperation for capacity building in Sri Lanka as well as international cooperation. The project partners are (1) the Department of Geodesy and Geoinformation, Vienna University of Technology (TUW), (2) the Faculty of Transport and Traffic, Dresden University of Technology (TUD), (3) the School of Rural and Surveying Engineering, National Technical University of Athens (NTUA), (4) the Faculty of Geomatics, Sabaragamuwa University of Sri Lanka (SUSL), (5) Departments of Town and Country Planning and Civil Engineering, University of Moratuwa (UoM), (6) the Faculty of Technology, University of Sri Jayawardhanapura (USJ), and (7) the Faculty of Computing, General Sir John Kotelawala Defence University (KDU).

Our approach to curricula development is executed in two phases — training and development. The training phase does not only focus on the materials and teaching but also introduces the teachers to a new pedagogic method, e-learning and quality assurance in teaching. The development phase focuses on the learning outcome definition, material development and holding the pilot courses before the end of the project’s lifetime. This phase also adapts the materials of the existing courses at each institution that need modernisation. This approach is in line with a statement in (Parashar and Parashar, 2012): “Curriculum overall can be viewed as a composite whole, including the learner, the teacher, teaching and learning methodologies, anticipated and unanticipated experiences, outputs and outcomes possible within a learning institution.”

In this paper, we will detail both phases of curriculum development and the educational and theoretical reasoning for introducing certain methods. We will also introduce Problem Based (e-)Learning (PBeL), a pedagogic method we first published in (Retscher et al., 2022). Lastly, we will provide an explanation of our comprehensive and integrated approach to the curricula development and modernisation that, in addition to cooperation between diverse project partners, includes consultations with various Sri Lankan government, education and private stakeholders.

The following section defines the topics of this project: LBS and ITS and provides some background knowledge. Sections 3 and 4 go into the core of the paper, which are the two phases of the curricula development. Finally, the last section concludes the paper and discusses future work.

2. BACKGROUND: PROJECT TOPICS

This section will briefly describe and connect the two main topics of the LBS2ITS project: Location-based Services (LBS) and Intelligent Transport Systems (ITS).

LBS applications are those that use the location of the user to improve some service (Küpper, 2005). They are mobile computer applications (e.g., smartphones) that deliver information tailored to the location and context of the device and the user. Synonyms such as location-aware, location-related and location services are often used for LBS as well (Küpper, 2005). With the integration of information and communication technologies (ICT) in every aspect of our daily lives, 4A (anytime, anywhere, for anyone and anything) ‘services’ are being developed to benefit our human society and environment (Huang et al., 2018). It also brings many opportunities (e.g., for traffic management and urban planning) and challenges (e.g., privacy, ethical, and legal issues) to our environment and human society. Examples of some LBS applications are shown in Figure 1. Transport has been one of the main application fields of LBS. Applications include those for driver assistance, passenger information, and vehicle management. Car navigation systems are probably some of the most popular LBS applications, which provide wayfinding assistance for drivers such as real-time traffic information. Crowd-sourced traffic and road information is used to provide, for instance, drivers with real-time navigation support. LBS and tracking techniques have now been extensively used for vehicle management and logistic tracking. In recent years, applications beyond car navigation and vehicle management have been emerging. For example, for driver assistance and passenger guidance, applications for finding available on-street parking spaces, safety warnings, and multi-modal routing have appeared. LBS promote more healthy, greener (lower CO_2 emission), and more active mobility behaviour. Consequently, pedestrian and vehicle navigation and guidance are a major focus in the courses of LBS education.

ITS applications aim at providing innovative services relating to different modes of transport and traffic management enabling the user to be better informed and make safer, more coordinated and ‘smarter’ use of transport networks. The definition of ITS has changed throughout history but the main goal has always been to make transportation safer and more efficient. (Auer et al., 2021) defined ITS as “operational systems of various technologies that, when combined and managed, improve the operating capabilities of the overall system”. ITSs are often seen as part of the larger concept known as smart or intelligent cities (Kołodziej et al., 2022). Figure 2 shows some of the components of the smart city and ITS such as priority traffic lights for bicycles, avoidance of busy areas for emergency services, safer home-school journey for children travelling, route planning, charging station selection, car sharing, street lighting optimisation (bIoTope Team, 2023). Many other components such as tramways and electric busses, attractive routing for

Figure 1. Examples of LBS applications (from (Huang et al., 2018)).

bikes and pedestrians, traffic management, air pollution, water quality, waste management etc., can also be found in the literature.

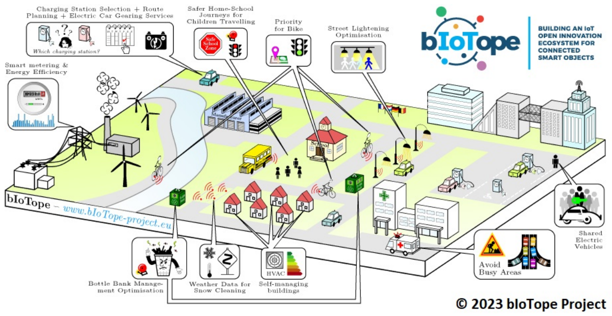

Figure 2. Abstract representation of the smart city components (from (bIoTope Team, 2023)).

It is clear from the high-level descriptions of LBS and ITS that both concepts are connected and the combination of the two is capable of improving city mobility and overall the quality of life in those cities. (Parashar and Parashar, 2012) stated that “the interdisciplinary, multidisciplinary, or holistic approaches in engineering courses are a positive step and curricular transformations and research is moving towards innovations”. It is clear that a single discipline cannot offer a holistic solution to the problem at hand (i.e., LBS and ITS). As mentioned in Section 1, the LBS2ITS project approaches the curricula development in these two areas from multiple disciplines including geomatics, surveying, cartography, urban planning, transport engineering, environmental engineering and computer science.

3. TEACHER TRAINING PHASE

The first phase of the curricula development is the teacher training phase. This phase has three main goals — introducing the new pedagogic method, coming up with a common Quality Assurance (QA) in teaching questionnaire and training the teachers in various topics related to LBS and ITS.

As mentioned in Sections 1 and 2, four Sri Lankan universities are involved in the project and five departments from those four universities. All five departments represent a different discipline — geomatics, urban planning, transport engineering, computer science and environmental engineering. Consequently, to plan for the content of the six train-the-teachers courses, we surveyed our project partners on courses they are currently teaching at their respective institutions and how they would like to modify them in the course of the LBS2ITS project. Survey questions are given in Figure 3.

1. Study level: Bachelor, Masters, ...?
2. Course name
3. Course administration via Moodle or similar?
4. Duration in semesters?
5. Hours (ECTS)?
6. Does course involve group work?
7. Number of groups per year?
8. Number of students per group?
9. Used pedagogic method?
10. Exemplary technical topics
11. Assignment examples
12. Aimed soft skills
13. Deliverables
14. Outcomes
15. Examination form
16. Examination implementation via Moodle or similar?
17. The change proposed from the project?
18. Do you plan to modify Learning Outcomes?
19. Do you plan to modify Outline Syllabus?
20. Do you plan to modify Lesson Plan/Mode of Delivery?
21. Do you plan to modify Learning Materials?
22. Do you plan to modify Assessment Method?
23. Provide a tentative list of teaching materials (topics) required to be developed from the project

Figure 3. Existing courses survey.

A list of topics that require further development from the LBS2ITS project was produced based on question 23 in the survey shown in Figure 3. There were 81 topic entries for 28 surveyed courses (i.e., some courses are interested in more than one topic). Rather than offering the topics to respondents, they were free to enter any topic. All 81 entries were classified into seven general topics as shown in Figure 4. The percentages reflect the scale of interest for each topic. The general topics are shown in Figure 4 and more detailed topics of interest for modernisation and development in the LBS2ITS project are:

1. Transport planning
   - Sustainable urban transport planning
   - Regional road and railway infrastructure networks
   - Logistics corridors
2. Smart cities
   - Smart city mobility
   - Smart infrastructure
3. LBS
   - LBS in ITS
   - Applications for environmental impact identification
   - Social media analytics
   - Individual carbon footprint reduction strategies
   - Land use and accessibility interaction models
4. Positioning, Navigation and Timing (PNT) applications
   - Multi-sensor positioning
   - Alternative PNT
   - Smartphone positioning
   - Low-cost sensors for positioning
5. Geovisualisation
6. Data/Spatial analysis
7. Interdisciplinary study project

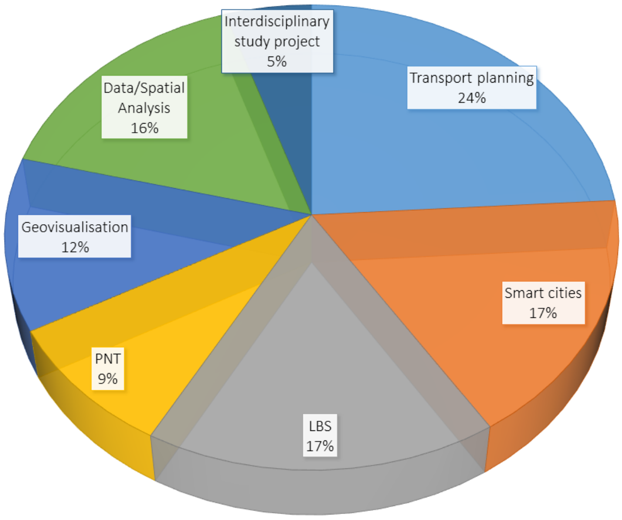

Figure 4. Survey result: Topics that require development from the project.

Having defined the topics of interest for Sri Lankan partner universities, we proceeded with the first phase. This phase is still in progress and is currently in its final stages. The following three sections go into more detail.

3.1 Problem Based Learning (PBL)

As part of this project, a workshop was held on the topic of e-learning and PBL pedagogy. All courses modernised or developed during the lifetime of the LBS2ITS project will implement the Problem Based Learning (PBL) pedagogy.

(Savery, 2006) and many other authors define PBL as a learner-centred pedagogic method. In PBL teachers facilitate learning, and students are in an active role and responsible for their own learning through solving real-world problems. Figure 5 provides a comparison of classical teaching methods and PBL. In classical teaching, the teacher gives lectures about what students should learn, students memorise the knowledge and apply it to a given example. When it comes to the examination, the students need to reproduce the told knowledge back to the teacher. Unlike classical teaching, in PBL, students start with the problem (either assigned by the teacher or found by them) and learn the theoretical knowledge on their way to solving the existing problem.

The PBL cycle common to much of the literature can be found in Figure 6. In the first phase, the students or the teacher define the problem. In the second phase, all students go through their *a priori* knowledge and brainstorm on how they can solve the problem with just the *a priori* knowledge. In the third phase, students as a group analyse the problem and collect all the independent ideas on how the problem should be solved. Finally, students, with the guidance of the teacher, define the learning outcomes. Self-study is the fifth step of the PBL cycle. This is a very important step of the process because students engage in learning in it. Unlike in classical teaching methods, students can choose how they learn — reading books and scientific literature, listening to webinars, attending seminars, etc. In this way, PBL can be adapted to anyone's preferred learning

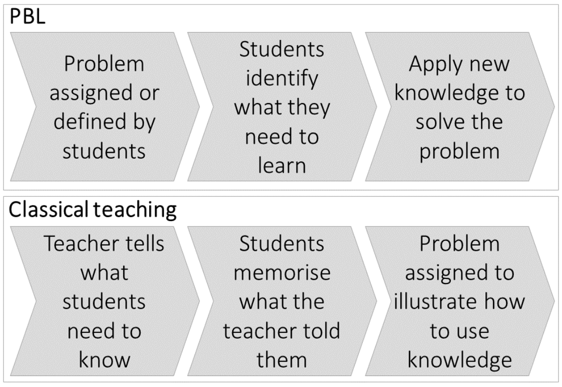

Figure 5. PBL versus classical teaching methods (according to (Abdullah et al., 2019)).

method. An additional benefit is that the students are not limited to literature and materials from a single discipline like they would be if a teacher was transferring knowledge from a single discipline. This step can be overwhelming to teachers as it requires more engagement than in classical teaching. Teachers should be there to offer help with the literature and literature understanding. The self-study step is the step where students will also learn the most to be independent and become lifelong learners, which is the goal of the PBL method itself. The sixth step of the PBL is generation of new knowledge where students have team discussions, synthesise their new knowledge and solve the real-world problem. In the final step, students are evaluated based on their work.

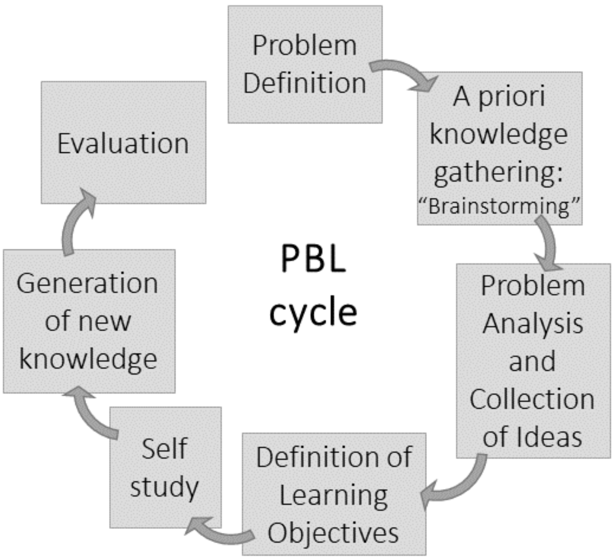

Figure 6. PBL cycle (according to (Retscher et al., 2022)).

Although present since the 1970s, PBL started to be applied in engineering education only recently (Gabela et al., 2022). When it comes to advantages and disadvantages, the literature has recorded many. The main advantages are the independence of students, self-awareness of students, the fact that students become lifelong learners and that their knowledge is rooted in real-world problems. Furthermore, the integration of theoretical knowledge and practical knowledge is better than with classical teaching. (Perrenet et al., 2000) noted a very important drawback of PBL when it comes to engineering education. On the example of mechanical and biomedical engineering, (Perrenet et al., 2000) concluded that some classical teaching methods are necessary for engineering education. This includes classical lectures and practical classes, which are necessary due to the hierarchical structure of the engineering knowledge where missing basic concepts can affect the success of the PBL. A similar conclusion was made in (Gabela et al., 2022) where we studied the application of PBL in geodesy, geoinformatics and transport engineering. (Gabela et al., 2022) concluded that, depending on the stage of the students' education, PBL can be implemented without any need for classical teaching methods if the students are in the finishing stages of their degree programme or with the need for many theoretical lectures if the students are beginners.

To overcome the clear drawback of PBL when it comes to engineering education, we proposed the PBeL concept in (Retscher et al., 2022). In it, a combination of PBL with distance and e-learning was conceptualised based on the lessons learnt from the Covid-19 pandemic where distance learning was a necessity. Primarily, this concept proposes that the need for theoretical lectures and practical exercises is addressed through the offering of webinars and lectures on e-learning platforms. This way, the students that already have appropriate *a priori* knowledge do not have to listen to the lectures again in the classroom and students that do not have this knowledge can acquire it through distance learning.

The research of PBL implementation in geomatics engineering is still in its infancy and not many published articles can be found. Some of the published research in the area is (Taboada et al., 2006, Božić et al., 2020, Gabela et al., 2022, Retscher et al., 2022, Höhle, 2005).

3.2 Quality Assurance (QA) in Teaching

The second important project workshop was held on the topic of Quality Assurance (QA) in teaching. The main aim was to develop a common questionnaire that will be used to develop an app-based solution for QA.

QA in teaching has become an important topic in higher education. (Steinhardt et al., 2017) analysed the emergence of research of QA in higher education. In their analysis, they demonstrated that the number of authors and the publication rate have been linearly growing since 1996.

Internal methods of QA in teaching are valuable in improving the universities' mission of teaching and learning (Tavares et al., 2017). (Tavares et al., 2017) analysed data from an online survey given to all Portuguese private and public higher education institutions in 2014/2015. In their survey, they looked for the academic perspective. They have found that academics acknowledge the contribution of the QA to an increased awareness of teaching quality issues. However, this has had only a limited impact on the improvement in teaching. A possible explanation, identified by (Tavares et al., 2017), could be the lack of pedagogic training given to academics. Another issue identified by the responders is the increased bureaucracy (i.e., non-academic) workload.

As indicated in (Tavares et al., 2017), the impact of QA surveys on teaching quality could be greater if the teachers have pedagogic training. The LBS2ITS project addressed this by training academics on PBL pedagogic method (as presented in Section 3.1). When the second phase of the curricula development starts, PBL and PBeL methods will be the key to the approach of curricula development.

As part of the QA workshop given for the LBS2ITS project, we presented the current QA in teaching methods at each of the partner universities. In our workshop, we addressed the issue of not putting too much non-academic workload on teachers and also increasing the number of students who participate in QA. From experience, partners who offered the most interactive and easiest way (e.g., digital) for students to respond to the survey, have gotten the highest percentage of students who participated. One of the outcomes of the LBS2ITS project will be an app-based solution for QA in teaching. The aim of this approach is to make it easier for students to do it on their smartphone devices or computers and to encourage more students to do it. Furthermore, this should decrease the non-academic workload of the teachers as they would only see the results they can use to improve their teaching. The app-based QA solution is currently in development and will be used by all partner universities.

In the QA workshop, we also conceptualised a common questionnaire that will be given to all students of our partners. The answers to all questions will be rating answers as shown in Table 1. The common questionnaire is shown in Table 2. The table shows that the students will be rating the lecturer, lectures and the materials, their relationship with the lecturer, and they will provide an overall course evaluation. Many of the questions shown in the table also address the pedagogic method based on which the lecturers will be able to adapt their approach. An additional questionnaire was developed for courses that contain practical or field-based exercises. This questionnaire is shown in Table 3.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
5	4	3	2	1

Table 1. Answers to the questionnaire.

3.3 Train The Teachers Courses

Following the training on pedagogic and QA methods, 6 train-the-teachers (TTT) intensive courses were planned where the teachers were introduced to topics relating to LBS and ITS. These topics are the core of this project and will provide an overview of the field from the perspective of multiple disciplines as indicated in Section 1. The topics have been chosen based on the needs of the Sri Lankan partners as presented in the survey in Section 3. The topic choices were also informed by the expertise of the European partners and their view of what is necessary for improving the education of LBS and ITS. Furthermore, Sri Lankan stakeholders such as private company owners or government officials, and Sri Lankan policies such as "National Physical Development Policy and the Plan 2050" (see Section 1) impacted the chosen topics for the TTT courses. All TTT courses (five out of six have been held) are:

1. Training on transport system planning for smart cities
2. Training on estimation theory and processing of spatial data
3. Training on data and models in transportation
4. Training on LBS and multi-media cartography
5. Training on alternative PNT technologies
6. Training on smartphone positioning techniques for in- and outdoor localisation

Evaluation of the lecturer	
1	Qualification of the lecturer was sufficient
2	The lecturer was confident in teaching the subject matter
3	Lecturer was punctual (Lecturer was present at the correct time)
4	Lecturer motivated me to do my best of ability
Evaluation of the lectures and materials	
5	Evaluation criteria were adequately described at the beginning
6	Lectures and tutorials were well structured and useful to understand the subject
7	Workload of this module was reasonable
8	The topics were substantially covered in the class
9	The continuous assessments were designed to help me learn
10	Supplementary learning materials were available and helpful
Evaluation of Lecturer-Student Interaction	
11	Lecturer facilitated and encouraged active discussions with students
12	Lecturer commended the students' responses
13	Self-study was encouraged
Overall Evaluation	
14	Overall satisfaction with this module
15	How beneficial was this module to sharpen your skills
16	Intended learning outcomes of the course were achieved

Table 2. Common feedback form.

Transport system planning for smart cities course was given by TUD. The goal was to train lecturers in terms of domain knowledge of transportation planning and traffic engineering. The course discussed goals, visions, challenges, and emerging trends in transport. The topics ranged from strategic sustainable urban mobility plans and functional street network classification to design principles for safe, efficient and liveable streets. The group work covered three topics — 15-minute-city, Next-generation public transport in Colombo, Sri Lanka and street design standards.

Estimation theory and processing of spatial data course was given by TUW. The goal was to introduce the teachers to some statistical basics of data analysis and to estimation theory. The participants learned about measurement deviations (random, systematic and gross errors), probability density functions, variance-covariance propagation, different error distributions and hypothesis testing, Gauss Markov Model, and Kalman Filter. Many practical exercises related to the lectures were done by the participants using the programming language Octave.

Data and models in transportation was given by TUD. The course provided an introduction to data analysis and visualisation with the programming language R. It also provided an introduction to transport modelling in MATSim. An agent-based transport simulation in Sri Lanka and transport behaviour analysis for different scenarios were run.

LBS and multi-media cartography course was given by TUW.

Evaluation of the Practical Task	
1	Adequate theoretical knowledge to perform the practical task was obtained from lectures
2	The task was well organised
3	The task cards were helpful in acquiring an understanding of the task
4	Adequate time was allocated for the task
5	Adequate facilities (equipment, software etc.) were allocated for the task
Evaluation of the instructor	
6	The instructor expressed ideas clearly
7	The instructor encouraged students to ask questions
8	The instructor carefully answered questions raised by students
9	Useful feedback was received from the instructor regarding my work in field
10	The instructor was readily available for consultation with students during practical class hours
11	Rate the practical task
12	Did you achieve your expected outcomes from this task?

Table 3. Practical/field base course modules (optional).

The course was conceptualised to offer the answers to *why-what-how* questions. It answered the questions of why is it important to teach students about LBS and cartography, what can be taught to students and how the teaching of these topics can be done. This concept also offered an opportunity for the teachers to have insight into how they should approach curricula development in the next stage of the project.

Alternative PNT technologies was given by NTUA and TUW universities. This course mainly dealt with Global Navigation Satellite Systems (GNSS) and their applications in all disciplines involved in the LBS2ITS project. The basic concept of PNT, coordinate systems and frames, GNSS concept and positioning techniques, positioning and navigation techniques for LBS and alternative PNT (i.e., multi-sensor and cooperative) have been presented. The participants learnt how to collect, pre-process and process GNSS data with the GNSS receivers purchased as part of the LBS2ITS project.

Smartphone positioning techniques for in- and outdoor localisation is the last train-the-teachers course that will be given in this project and it will be given by TUW and NTUA universities. A large range of topics will be covered — localisation and tracking of mobile devices with GNSS, ubiquitous smartphone localisation, indoor user localisation, Wireless Fidelity (Wi-Fi) positioning, vision-based positioning, inertial navigation using smartphone sensors, sensor integration and fusion techniques, etc.

The smartphone positioning course will officially conclude the teacher training phase of the project and the development phase will officially start.

4. DEVELOPMENT PHASE

The next phase of the project relates to the development of the teaching materials, the development of the new courses and the modernisation of existing courses before the end of the project. As implied in the previous sections, this phase is yet to begin. In this section, we will focus only on the development of new courses and our planned approach.

Like the previous phase, this phase also requires workshops. The development phase will include only one workshop on the topic of *Core curricula course modules development*. The aim of this workshop is to define all new courses, and competence matrices with respect to competence types for them. In this workshop, learning outcomes for all courses will be defined, as well as the lesson plan, PBeL implementation will be defined, etc. Figure 7 demonstrates how the entire project should flow from the first phase through the second phase to the development of new courses.

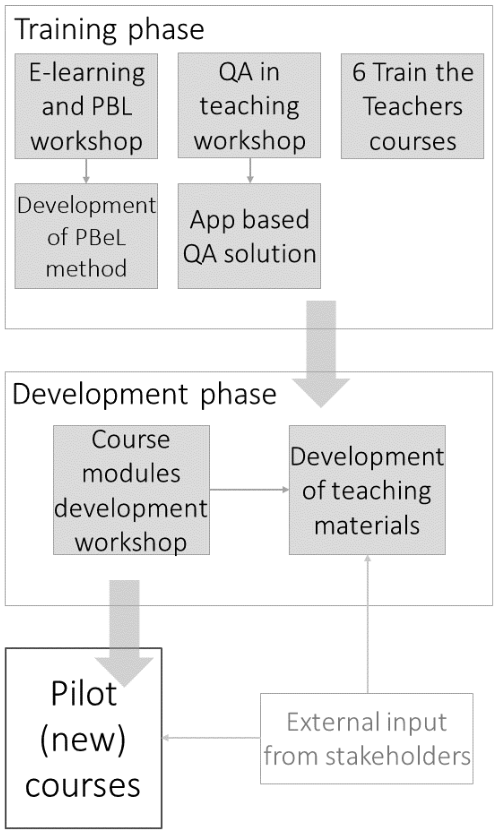

Figure 7. LBS2ITS approach to curricula development.

(Bussemaker et al., 2017) demonstrated how they used the ontology approach for chemical engineering curriculum development. As shown in Figure 8 from (Bussemaker et al., 2017), they defined three high-level classes of concepts — *Module* for modules/courses, *LearningOutcomes* for learning outcomes and *Topic* for the topics covered in the courses. The figure also shows that all three concepts are logically connected through the object properties such as *hasLearningOf*. The workshop on the curricula development held as part of this project will cover the first two ontology concepts shown in the figure. A systematic approach similar to the one shown in (Bussemaker et al., 2017) will be adapted to the LBS and ITS education. Furthermore, the topics of each course will be defined based on the knowledge of teachers and the new knowledge acquired in the teacher training phase.

Each partner university will decide which modules they want to introduce to their institutions within the frame of the LBS2ITS

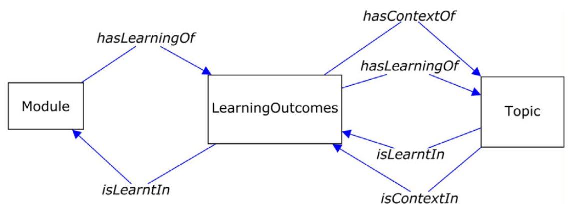

Figure 8. High-level ontology from (Bussemaker et al., 2017).

project.

The learning outcomes for each course will be defined based on Bloom's taxonomy. Bloom's taxonomy is "a multi-tiered model of classifying thinking according to six cognitive levels of complexity" (Forehand, 2005). Original Bloom's taxonomy was adapted to use active verbs — remembering, understanding, applying, analysing, evaluating, and creating (Forehand, 2005). Each task given to the students, not just the learning outcomes of the course, can be defined using Bloom's taxonomy. A simple example of this was given in (Retscher et al., 2022) where setting up a tripod was described:

1. Remembering — "describe the procedure for setting up and levelling a tripod on a measuring point"
2. Understanding — "summarise what the main steps are"
3. Applying — "try it out in the field"
4. Analysing — "differentiate between centring and levelling"
5. Evaluating — "assess the right procedure"
6. Creating — "create a list of steps to be followed"

Figure 7 also shows that external stakeholders will have input in the curriculum development. This is done to ensure the project's relevance to Sri Lanka overall and the sustainability of the newly developed curricula. Stakeholders will make the industry/governments/society needs known so that the curricula can be developed. (Parashar and Parashar, 2012) expressed a similar goal when they stated that a few factors influence curricula design — political, social, economic, technological and environmental. They also stated that the curriculum needs to be developed in light of the context in which it will be delivered. External stakeholders are part of the Advisory Board of the LBS2ITS project. They come from government organisations, non-government organisations, private companies, other educational institutions, etc. Their main role is to advise the project with the goal of ensuring that covered topics are relevant to Sri Lanka and its development as mentioned in Section 1, and to ensure the employability of graduates and their added value to the Sri Lankan society.

The pilot courses developed in this project will be held in 2024.

5. CONCLUSION

This paper offers a systematic overview of how the LBS2ITS project approaches curricula modernisation and development. The end products of the project are the pilot courses and modernised existing courses at four Sri Lankan universities. With this, the LBS2ITS project is aiming to introduce Sri Lankan partners to the methods of curricula development, new pedagogic methods, e- and distance learning, QA methods, modern topics of LBS and ITS to ensure the production of good engineers with up-to-date knowledge who will be life-long learners. These engineers will be crucial in Sri Lanka's recovery and development. This goal of the project is in line with the Sri Lankan "National Physical Development Policy and the Plan 2050, 2018". In this policy, Sri Lanka wants to "update the workforce of the country by disseminating knowledge to maintain the ongoing developments to the state-of-the-art smart transportation standards as practised by developed and well-organised cities".

Even though the curricula development presented in this paper is within the frame of the ongoing project, some lessons can be generalised and used by anyone. This paper offers a step guide for the approach to curricula development in geomatics or any engineering discipline by finding answers to questions:

1. Are students content with courses currently offered at your institution?
2. Are your students easily employed following graduation?
3. What knowledge is currently needed in the industry job positions?
4. What will be needed in future for the development of the country/region/city?
5. Do you want to develop new or modernise the existing courses?
6. What are the topics you need to introduce/modernise?
7. Do these topics cover multiple disciplines?
8. Can you cooperate with experts from other disciplines to come up with a set of topics?
9. What are the learning outcomes of the new/modernised course?
10. How will you deliver the course to students?
11. Do you need to do any training in new pedagogic methods?
12. Do you need to use any new technology to deliver courses (i.e., e-learning)?
13. How can you improve your course, course content, and content delivery based on the students' and stakeholders' feedback?

The LBS2ITS project is currently in the final stages of Phase 1 — teacher training. Soon, we will start Phase 2 — development and in 2024 we will hold our developed pilot courses and modernised existing courses. The assessment of the curricula development and the success of the pilot courses will be analysed and published in future.

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