Piloting the Learning by Development Action Model Pedagogy in UK HEIs

Taina Lintilä
School of Computing
Robert Gordon University
Aberdeen, United Kingdom/
Haaga-Helia University of Applied Sciences
Helsinki, Finland
taina.lintilae@rgu.ac.uk
taina.lintila@haaga-helia.fi

Mark Zarb
School of Computing
Robert Gordon University
Aberdeen, United Kingdom
m.zarb@rgu.ac.uk

Abstract—**This Research to Practice full paper presents pilot implementations of the Learning by Developing (LbD) at a higher educational institution in the UK as part of a project-based module. The study analyses the students' experiences of LbD and perceived development of their competence via a self-assessment survey and presents these alongside interviews carried out with other stakeholders involved in these study modules (lecturers and project clients).**

The primary purpose of this study is to research whether the LbD pedagogical model is a suitable learning method for computer science students in a higher education context in the UK. The method has been used as a teaching method at Laurea University of Applied Sciences (Finland) since 2004 as part of its underlying strategic model. Still, little research has been carried out on the benefits of this pedagogical model outside the Finnish educational structure. LbD strives to develop students' general working life skills during their studies, which is essential in higher education today. LbD also emphasises the importance and value of continuous learning.

Keywords—computer science, collaborative learning, teaching skills, pedagogical content knowledge, student experience, learning by developing

I. INTRODUCTION

The study aims to determine the perception of computing students with a study module implementation based on the Learning by Developing (LbD) action model used at Robert Gordon University (RGU) in the UK. The study aims to determine how students' competence develops during the study module and what their broad experience of learning is according to the LbD action model. The primary purpose of this study is to research whether the LbD pedagogical model is a suitable learning method for computer science students in a higher education context in the UK. The LbD action model has been developed at Laurea University of Applied Sciences (Laurea) in Finland by closely examining teaching and learning in Universities of Applied Sciences [1]. The LbD action model has been used at Laurea since 2004, and it is a successful way to teach new things in higher education [2]. In the LbD action model, a new way of learning, acting and renewing work life is essential.

This study aims to determine whether the LbD action model is a good learning and teaching method for RGU computing students' study modules involving a project-based module with real-world projects. Computing students have been chosen as the research subjects because studies that only examine the experiences of computing students in teaching according to the LbD action model have not been conducted before. An essential issue of the study, besides the student's own learning experiences, is how their problem-solving skills and other common working life competencies develop in the LbD action model projects that have been implemented in cooperation with the working life. The study also examines the lecturers' experiences using the LbD action model and its suitability for computing studies. Also, it looks at the clients' experiences in the study module on using the LbD action model in real customer projects.

This study reports the results of pilot studies conducted at the Robert Gordon University (RGU) in the fall semesters of the 2020-21 and 2021-22 academic sessions. The research results for the implemented study modules have been combined, as in 2020-2021, only one student responded to the survey. The study modules in both years corresponded to each other, so it was possible to combine these results. This study aimed to determine whether the LbD action model could be introduced in a different educational context to the one where it originated. This study aims to identify topics that should be considered in the further development of LbD to meet the future needs of international universities.

II. BACKGROUND OF THE LEARNING BY DEVELOPING

A. Dual model and the University of Applied Sciences (UAS) Act

The so-called dual model is used in Finnish higher education. Both the Universities of Applied Sciences (UAS) and universities have their role. The role of UAS is more focused on professional and practical skills and applied research, mainly for business needs. At the same time, universities carry out more basic and advanced scientific research [3]. One of the starting points for this has been the Bologna process since 1999, where the Ministers of Education of 29 countries agreed on a shared vision of a European Higher Education Area (EHEA). One of the essential issues in the Bologna Process and the EHEA has been identified as crucial student-centred learning. Student-centred learning, as a whole, influences the learning/teaching process and can only work if both students and teachers are ready to engage in

constructive dialogue and a collaborative learning process that develops valuable knowledge and creates favourable learning environments. [4.]

The University of Applied Sciences Act was passed in Finland in 2003. This law defines the tasks of the University of Applied Sciences (UAS). The latest version of Chapter 1, Section 4 of the UAS Act 2014, states that the task of UAS is to provide higher education based on the requirements of working life and its development, as well as research, artistic and cultural background and support for students' professional development. The second section of the fourth section of Chapter 1 of this Act was amended in 2018. The amended Act states: The University of Applied Sciences is also responsible for applied research, development, innovation and artistic activities serving UAS education, promoting employment and regional development and modernising the enterprise structure. In carrying out its tasks, the University of Applied Sciences must provide opportunities for continuous learning [5].

B. The Learning by Developing (LbD)Action Model

Laurea has implemented the Learning by Developing (LbD) Action Model [6] to provide students with advanced and future-oriented pedagogical support. LbD is based on pragmatism, and it focuses on a development project that is genuinely connected to real-life workspaces [7]. Learning by Developing was already used in the early LbD development process, with a strong background in applying exploratory learning [8] to teach. Later, a closer look at the philosophical underpinnings of the concept of learning revealed a pragmatic idea of learning behind it [9].

The features of LbD are authenticity, partnership, trust, creativity and an exploratory approach in which all partners participate as equals, sharing experiences and finding meanings to produce new knowledge in their different roles and responsibilities [6]. LbD is not only a learning process but also a process of reasoning and research. It helps students continuously exchange knowledge and skills according to the project's requirements. At the same time, LbD supports students to reinvent their skills, knowledge, and even identity. The goal of LbD is to prepare students for working life and for changing it in the future.

III. RESEARCH STRATEGY, METHODS & GOALS

The research strategy chosen for this study is action research, which is discipline-based research conducted by a teacher to seek information and change their practice in the future [10]. Participants systematically and carefully review their teaching practices using research methods in the action research process. [11]. The whole school faculty, a group of teachers with a common problem, or only one teacher can participate in an educational activity survey [12]. The action research fits into the research strategy, as the study aims to develop LbD-based teaching practices by researching them in three different higher education institutions. The LbD action model has been used at Laurea since 2004. Before this study, background information was collected from the literature and pedagogy expert through an interview to clarify the current situation. Conducting this background study is essential because it provides information on the starting point and background factors for piloting LbD at RGU. The expert interview also included information on the current pedagogical solutions at RGU, which was vital in piloting LbD at RGU.

At Laurea, more LbD-related research has been conducted among students in the social, tourism, and restaurant industries, but not specifically among students in computer science. One of the aims of this study is to determine if the LbD approach is a suitable learning method for computer science students and to find out their learning experiences through LbD and how their skills develop in the LbD-based study module. In the research cycles related to the action research study module at RGU, research material was collected from computer science students with the help of a questionnaire. Research data were also collected through interviews with lecturers and clients. The clients are genuine representatives of working life selected for the study module. The interviews explored how well the LbD action model, in the lecturer's view, fits into the computing student study module and how the lecturers' should be trained to use LbD to make it work properly. The customers were real-life customers. The purpose of the customer interviews was to find out how useful they found participation in the LbD-based study module in the role of the customer and how well this model suited the needs of the customers, and how well it was implemented.

The action research proceeds periodically from the situation under investigation. Based on the researched information, the researcher gets an idea of the current state and starts planning the target state based on it. The researcher participates in the development process, reflects on the situation with other participants and further develops it. This research cycle examines the research cycles performed at the RGU in the fall of 2020 and 2021.

The primary research method consists of method triangulation. Methodological triangulation means, for example, that several data collection methods are used to acquire research data [13]. The data collection methods used in this study are a survey of students and a thematic interview of lecturers and clients. Narrative analysis has been used to interpret students' free-form responses and lecturer and client interviews. In narrative research, the meanings of human action and phenomena are constructed in various stories that are important to explore. The narrative can also be used in interviews. A narrative perspective helps outline entities built on individual meanings and interpretations at the personal and community levels. Narrative analysis is suitable for the analysis of research because the object of research changes in one way or another, and at the same time, the cultural background is also studied. In narrative research, background information may be essential, as the researcher may be interested in relating the texts to their narrators and the contexts of the narrative. In this case, narrators can be thought to play a significant role as narrators and plot creators. In narrative research, type reports are often - not always - called, e.g. content reports, summaries, and plot summaries. In this study, all interviewees participated in the survey in different roles. Therefore their "stories" have their content analysed in the form of a narrative. A small number of students responded to the study, so narrative analysis is also warranted in interpreting these responses. [14].

Mean, and standard deviation are used to aid in quantitative research. The mean is a general measure in the quantitative analysis used to compare estimates. However, the mean does not indicate the frequency of mean observations. For this reason, the standard deviation is also usually used. The standard deviation is helpful if the observations follow a normal distribution. In addition, if we know the mean and standard deviation of a set of observations, we can obtain

valuable information by a simple arithmetic method. [15]. Students' quantitative responses are analysed using means and standard deviations.

IV. THE RESULTS OF THE STUDENT SURVEY

The topics of this research cycle were computer science students who participated in a project-based study module at RGU in the fall of 2020 and 2021. The module in question was a second-year Software Engineering module (15 ECTS) delivered to Online Distance Learning (ODL) full-time students. In the autumn of 2020, 12 students participated in the study module and only five students in the autumn of 2021.

In the LbD action model, learning is a tool for achieving new competencies, reflected in new forms and ways of working. LbD offers students and teachers a real encounter with working life and a model for working together as innovative partners. The learner learns to identify areas for development, create new solutions, products and operating models, and develop their operations considering the changing requirements of working life. [16].

LbD is characterised by authenticity, partnership, experience, creativity and research. Authenticity means a genuine connection to working life. A research and development project close to working life is seen as a learning environment that enables the formation of new ways of working. The partnership means responsible collaboration between students, teachers, working life experts and clients, to which they are committed together. The partnership is built on trust and is equal. Experientialism can be understood from different perspectives. First, experiences build knowledge with the meanings given to them. Second, experientiality can be viewed in the light of the processes leading to the formation of new ways of working. Creativity is key to creating something new. LbD is based on the ability to operate in an ever-changing world, so working for change is a natural approach. Demand for research arises from the context of higher education. [16].

The teaching method of the study module was the LbD action model, the main principles of which were already familiar to the lecturer. The researcher also went through the LbD principles with the students at the beginning of the study module. The project-based study module was chosen as the research topic because the students participated in the project implementation related to developing working life in cooperation with a genuine client [17].

Students did independent and group assignments and a development project related to working life in cooperation with the client during the study module. The researcher told the students that at the end of the study module, the researcher would conduct a survey, which would be used for research purposes. Clients were asked if they could participate in an interview related to this study after the study module.

The study aimed to obtain information on how students' skills develop during the study module and what kind of learning experiences they have from implementing a study module by LbD. In particular, this study aimed to determine whether and how well the LbD approach fits and is it a good and effective way to study computer science. In addition to the student survey, research data were also collected through interviews with lecturers and customers. They were asked about their experiences of participating in implementing the LbD study module in their role.

Thus, the research material was collected in different ways: through student surveys and interviews with customers and lecturers. The student survey and interviews with customers and lecturers were conducted at the end of the study period. The student survey included questions classified according to the Likert scale and free-form questions. Only one responded to the query of the 12 students in 2020. All five students in 2021 responded to the survey. Since there are only six respondents in both implementations, these responses were combined into the same set to be analysed. The study modules corresponded to each other, and the same lecturer and the same client were involved in both implementations. Both study modules were at a time when COVID-19 imposed restrictions on studies around the world.

The development of students' competence was mapped using several questions based on the University's general competence areas defined in Laurea's strategy for 2030 [18]. Laurea has strongly identified the skills needed for working life alongside the degree's substantive skills. They are perceived as increasingly essential skills for those who have completed applied sciences higher education. These Laurea general working life skills, common to all degrees, consist of six competencies: self-management and entrepreneurial attitude, critical thinking and problem-solving skills, foresight and innovation skills, communication and interaction skills, global skills and responsibility skills. Therefore, these competency developments in all studies were taken as the basis for a survey of students.

Each set of competencies contains three or four more detailed sections, the development of which is assessed by the students in the survey. Students evaluate the development of their skills through self-assessment in these subject areas. They defined the level of competence in each section before starting the study module and the level of competence at the end of the study module. This article presents a few examples of these results. When interpreting the answers, it should be noted that these students' self-assessments affect the reliability of the results. However, the purpose of the study is to obtain authentic answers from students about their experiences with the LbD project.

A. Students; surveys results in classified questions

The first set of competencies was self-management and entrepreneurial attitude, and the first section in that set was life management and well-being. Students were asked to rate their competence in each subject area on a scale of 1 (" no competence") to 5 ("expert"). The results can be seen in Figure 1. At the beginning of the study module, students' average competence was 3.00, and the standard deviation was 0.58. Students' competence average at the end of the study module had risen to 3.83, and its standard deviation was 0.37, so the variance had decreased at the end of the study module.
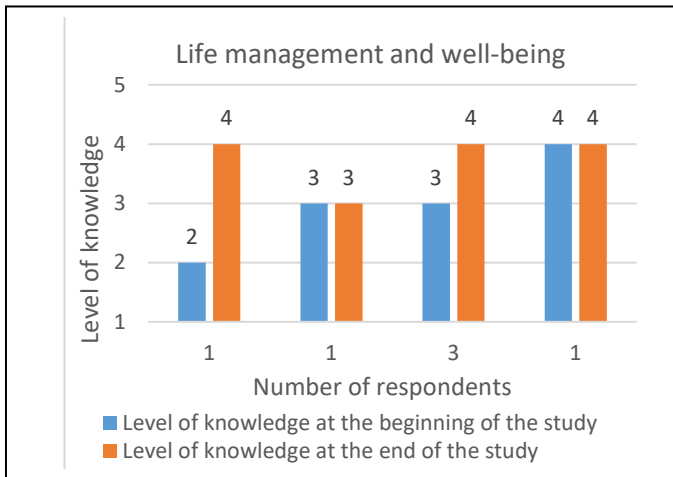
Fig. 1. Students' survey results for Life management and well-being

Students were also asked to rate how well they felt they could self-assess their competencies and continuous learning abilities. The results are depicted in Figure 2. The reported mean was 3.00 at the beginning of the study module and 3.67 at the end. The standard deviation was 0.58 at the beginning of the study module and 0.47 at the end of the study module. The change was not significant, but the variance had also decreased, i.e. after the study module, the differences in students' competence levels had been reduced.
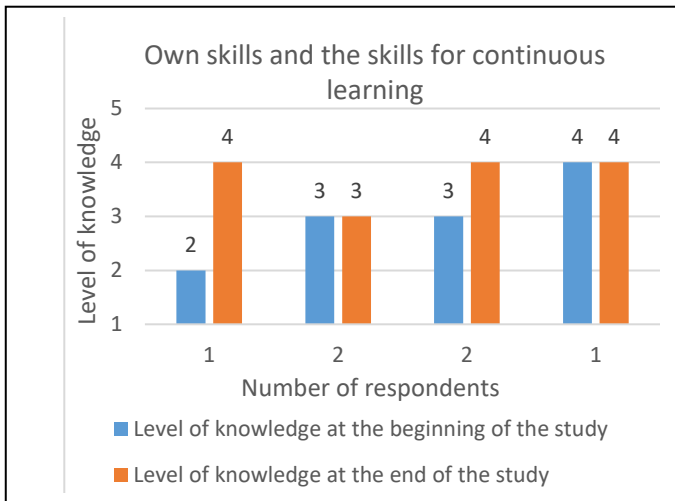

Fig. 2. Students' survey results for Own skills and the skills for continuous learning

The second set of competencies in the query was critical thinking and problem-solving abilities, which included three points to be assessed. The results are reported in Figure 3. The average of these answers was 2.50 at the beginning of the study module and 3.33 at the end. At the beginning of the study module, the standard deviation was 0.76 and 1.11 at the end. These answers show an increase in invariance at the end of the study module. The second set of competencies in the survey was critical thinking and problem-solving ability, which included three points to be assessed. The results are shown in Figure 3. The average of these answers was 2.50 at the beginning and 3.33 at the end of the study unit. At the beginning of the study module, the standard deviation was 0.76, and at the end, 1.11. These responses indicate an increase

in invariance at the end of the study module. The change is because three students estimated their competence had developed to level four. One student estimates that the level of competence is at level one, and according to the student's assessment, it did not increase at all during the study module.
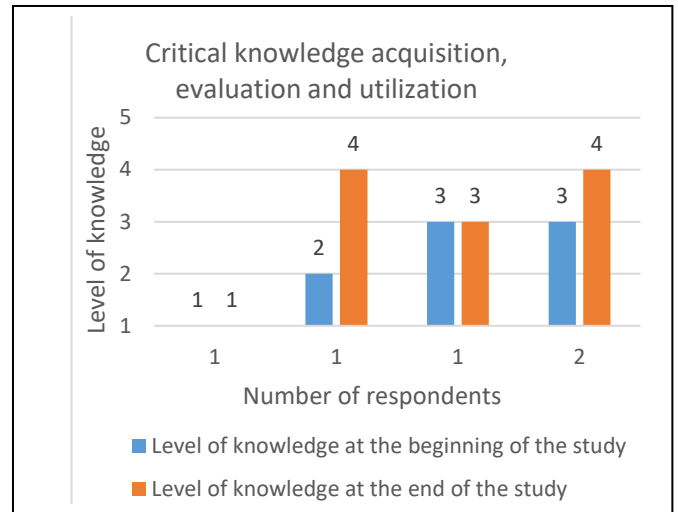

Fig. 3. Students' survey results in Critical knowledge acquisition, evaluation and utilisation

The next question in this section was entity management and systematics. The results are reported in Figure 4. The reported average in these responses was 2.33 at the beginning of the study module and 3.17 at the end. The standard deviation of the answers was 0.75 at the beginning of the study module and 0.69 at the end. One student rated the starting level as 1, i.e. no competence at all, and according to the assessment, it increased to level three during the study module. This competence area is an exciting area of research because it is an essential skill for students and helps students manage their studies, and is also a vital skill in working life.
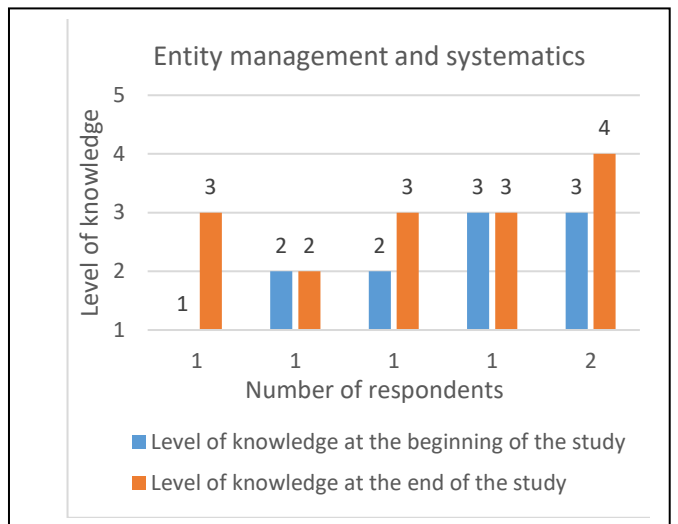

Fig. 4. Students' survey results in Entity management and systematics

The third issue at this point was analytical thinking and argumentation. The results are reported in Figure 5. The average reported at the beginning of the study module was 3.34, and four students had chosen competence level 3. Three of them estimated that their competence level had risen to

level 4 during the study module. The average at the end of the study module was 4.00. Two students chose to start at level 4; one student's level remained the same, and one estimated the level had risen to level 5. The standard deviation was 0.47 at the beginning and 0.58 at the end of the study module, i.e. the variance increased because one student estimated that the level of competence had risen to five and that one student estimated that it did not increase at all.
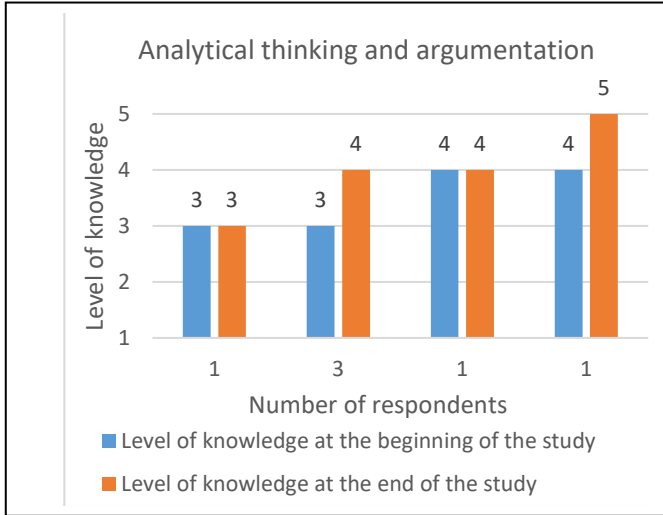

Fig. 5.   Students' survey results in Analytical thinking and argumentation

These are just some of the results of the study. A more detailed analysis of the results is ongoing and compiled into final research to analyse the results more broadly. In the first cycle of the study, the same issues were studied in the Laurea computing students' study module in the fall of 2019. Thirty-one students in that study module, 29 of whom answered the questionnaire[19]. In this study, the results from two different study modules have been combined, and there are only six respondents, so the figures are not very comparable.

The following research cycle will occur at Haaga-Helia University of Applied Sciences (Haaga-Helia) in 2022. After this research cycle, the results will be compared between at least two Finnish universities. The comparability of the results of the UK study is not very valid, but the results are still indicative. These results provide further information on using the LbD Action Model in an international context. The research results help evaluate the strengths of the LbD Action Model and find areas for improvement. The study also provides essential information on the background factors required to introduce the LbD Action Model.

B. Students; survey answer for free-from questions

In addition to numerical self-assessments, students were also asked to respond freely to what new things or skills they learned during the study module. The students' verbal answers are analysed in more detail using the content analysis method as the research progresses, but this is a compilation, by way of example, of the students' answers to a few questions posed in the questionnaire.

The first free-response question was: What new things and/or skills did you learn during the study module? Here are authentic answers given by students:

"Group working - teamwork, study skills, multi-tasking - working full time and studying, managing time efficiently"

"A way of working. A variation of tools already in use."

"I have learned quite a bit about software development and engineering through a mix of course learning and work-based learning."

"It's been a long time since I've needed to make time to study alongside the pressures of working full time, family life, etc. I think the module forced me to rethink and re-evaluate the most important use of my time."

"developed a wider understanding of the artefacts and planning of a project."

"How to work as a team to develop a piece of software. Teamworking skills. Planning skills. Presentation skills."

Most of the students indicated that they had learned things by the objectives of the study module. The topic of the study module was software development and agile methods, and during the study module, the groups participated in an actual customer project. There was only one customer project in which students participated. All students were employed full-time studying alongside work.

Students were also asked how well they felt they understood what LbD meant in practice. The scale was 1 ("no understanding") to 5 ("very good understanding"). It can be seen from Figure 6 that more than half of the respondents felt that they understood the meaning of LbD well in practice. One student answered that the level of understanding was 1, i.e. not no knowledge. One student rated understanding level 4, and the rest estimated it level 3. Students were also asked to describe the LbD approach in practice verbally.
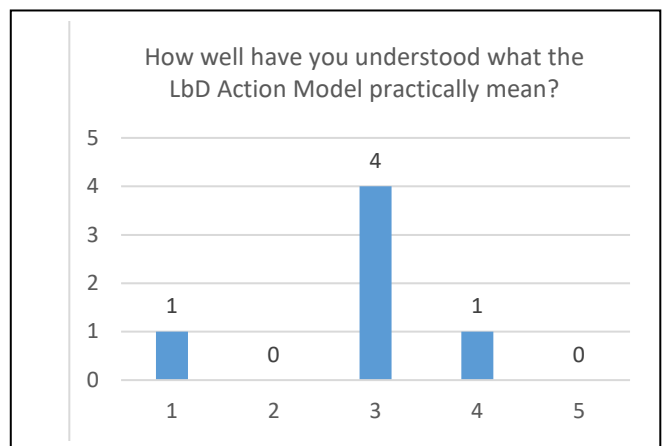

Fig. 6.   Students' opinion of understanding what the LbD approach means in practice

The answers to numerical self-assessments compared to verbal descriptions are pretty well aligned. A student who assessed that they had no understanding of LbD (level 1) answered, "I don't know." A student who rated their level of knowledge as 4 wrote that LbD is about doing by learning and more independent and group learning than the traditional way of learning.

Students were also asked how appropriate they considered the LbD in computer science studies. Figure 7 shows that half of the students chose level 4. Two chose level 3, and one chose level 2. Oral responses indicate that the LbD is initially an excellent way to combine practical tasks with learning. One student thinks that understanding their level of competence in the IT field is very important to develop their competence continuously. One student felt the challenge was that at the beginning of the project, it was unclear in terms of resources who knew what and how the students would commit to the project.
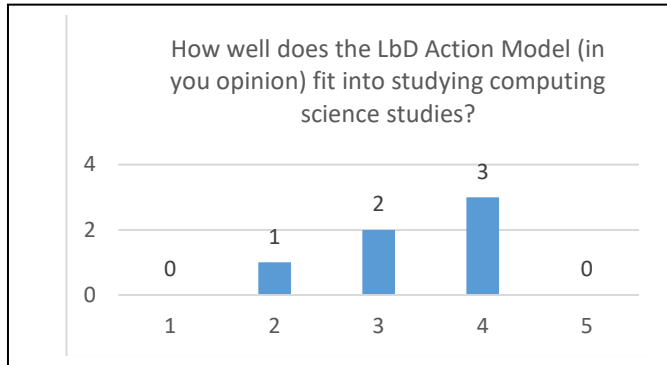

Fig. 7. Students' opinion of how well does the LbD Action Model fit into studying computing science studies

Students were also asked how well they thought LbD was appropriate for the study unit in which they participated. Figure 8 shows that the response was similar to the answers concerned with computing science studies.
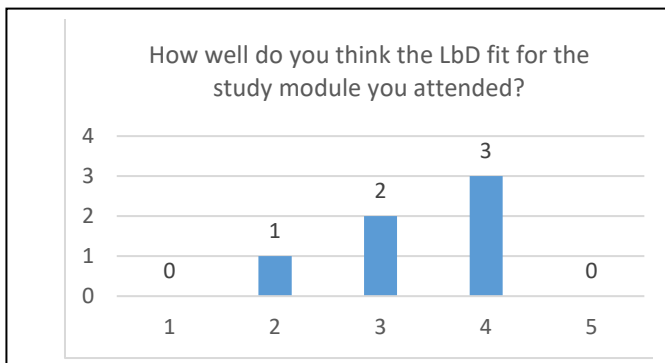

Fig. 8. Students' opinion of how well does the LbD Action Model fit the study module you attended

The verbal answers were also similar to the question related to the computing course. From these responses, it can be concluded that some students felt that the LbD approach was well suited for such a study and that they thought they had learned and embraced things more deeply because they were able to apply what they learned in practice in real client projects. Not everyone was quite sure if this method was so compelling and promising. One student found it challenging because studying alongside work is otherwise stressful. In the LbD projects, students have to take more responsibility for developing their competencies and work closely with the client, lecturers, and other students.

V. THE RESULTS OF THE INTERVIEWS

The research also collected research material from the lecturers of the Software Development study module through thematic interviews. The study aimed to determine what experiences the lecturers have about using the LbD action model in teaching and how suitable a teaching method is for the Software Development study module. A thematic interview was also conducted for the clients who participated in the study module to get information about their experiences using the LbD action model in their projects. Thematic interviews were conducted remotely and transcribed to provide a more detailed analysis of responses.

A. The lecturer; thematic interview

This article discusses the response of one lecturer from two different course implementations related to his experiences of using the LbD and its applicability to the software engineering study module. The same lecturer was teaching in both years in these study modules, and here are the combined responses to these interviews, which did not differ much.

When asked, *"How well do you think the LbD fits into RGU?"* the lecturer who taught computer science students answered that it fit very well depending on the context. The lecturer thinks it works better in some modules than in others, but he believes it fits well in the module in question. The lecturer replied that the LbD model is unsuitable for all study modules. In the lecturer's opinion, LbD is well suited for project-based modules involving an external stakeholder, such as a genuine client, and when it is not just lecture-based teaching. The lecturer said it was his job to adopt this model and be responsible for the curriculum. He also said that he had to ensure that the introduction of LbD works with the learning outcomes and objectives of the study module. He continued that when designing a study module, such as software engineering, involving an external client, the best way to integrate student learning into the LbD approach must be found.

The answer to the question *"How well does the LbD action model fit into the study module where you were involved in teaching"* was: it fits well. The lecturer said that the study module existed before he was aware of LbD, but due to the nature of LbD, it was straightforward to reorganise things and make sure you were following the principles of LbD. In the lecturer's opinion, the use of LbD in this study module aided all students being also full-time employees. Using LbD to combine work-based and university-based learning was facilitated because students were full-time employees. As a lecturer said, *"I think LbD worked well in this situation."*

The lecturer was asked what good he sees in the LbD model. According to the lecturer, LbD requires a lot from all participants because it requires the lecturer to rethink things and requires students to commit to their learning in a more active press. Because it is developing by learning, the good thing about it is that if students understand it and genuinely agree, it can be a productive thing for students. According to the lecturer, the strength of the LbD is that it requires all stakeholders to take responsibility for cooperation and professionalism.

The lecturer was also asked what shortcomings, weaknesses or treats he thinks there are. Here are the lecturer's answers. According to the lecturer, there are weaknesses and shortcomings in every pedagogy. If the pedagogy models are

not used properly, or someone does not understand why they use them in their study module, it has no value. A weakness can be if people try to use it without understanding what LbD is. LbD must be used in a suitable environment; otherwise, it will not work as it should. The last question was: *"How well do you think the students' skills developed during the study module?"* In the lecturer's opinion, students' skills developed very well, although this class was a little different from many other groups of students. The students involved were full-time employees, so they were already accustomed to communicating professionally. From a theoretical point of view, they learned to apply the skills they already had at work to a more academic environment.

B. The client; thematic interview

This article describes one client's responses to two different study module implementations related to her experiences of participating in a student project implemented using the LbD approach. The same client participated in these study modules in both years. However, the projects implemented during the study modules were different. Here are a few of the combined answers to the client questions asked in the interviews. Customer responses for 2020 and 2021 are marked here separately. The first question was: *"How well do you think the students succeeded in the project you were involved in?"*

- The year 2020 answer: *"I think to be honest I think, they did actually quite well."*
- The year 2021 answer: *"Really well, they took on the challenge and produced some good work."*

The second question was: *"How well did communication work with students during the project?"*

- The year 2020 answer: *"I think the communication worked quite well, and the students seemed to learn and know sort of what to ask, and I think through like obviously the way that lecturer been teaching it. So, I think it worked well, and I got quite a lot. I got the end product for what I envisioned visualising of gain."*
- The year 2021 answer: *Communication was good from the start to the end of the project. I was updated frequently with minutes and actions from each meeting and was involved in approving designs and information throughout."*

The client was also asked if there were any problems or challenges during the project. And if there were problems or challenges, how they were resolved. The customer's responses indicate that one of the challenges in both years was working remotely, caused by COVID-19. In 2020, one challenge was that the students did not initially know how to tell the customer technical issues in a language that the customer understood. The customer had no technical background or understanding of IT terms and originally had challenges. After the students realised that the client needed to be able to speak in an understandable language, this problem was solved, and the collaboration went well.

The customer was also asked whether the project achieved the set goals and whether it brought innovations and new ways of working to the organisation in the future. The client said that the purposes of the project were achieved very well, although there was still some work to be done to complete the tasks. If there had been a little more time available, the result would have been even better. New ways of working or innovations may not have come out of the project as such, but the involvement of students brought a somewhat unique way of thinking to the organisation.

At the end of the interview, the researcher also asked the LbD Action Model questions. The questions asked of the customer were:

- *Before starting the course, did you know the Learning by Developing (LbD) Action Model?*
- *Do you think the LbD approach is a suitable model for such client projects?*
- *What could be the best in LbD in such student projects?*
- *What weaknesses do you see in LbD approach?*
- *Do you have any idea how the LbD approach could be developed?*
- *What situation or project do you think is best suited for the LbD Action Model?*

In 2020, the client participated for the first time in the LbD project. At that time, the LbD approach was relatively unfamiliar to the client. The researcher told the client more about the LbD model and its principles during the interview. The same customer was also involved in the 2021 survey, and then the LbD model was already familiar to the client. In the customer's opinion, the LbD model is absolutely the most suitable model for customer projects. The best thing for a client is that LbD is a different way of working than usually listening to lecturers and doing a practice based on it. The client has noticed that students develop and gain more self-confidence throughout this project. A weakness or challenge for the client may be that students are not accustomed to this type of teaching style, so it takes longer for them to understand the concept of LbD. The client also believes that this way of working may work well for some students but may not be the best learning structure for all students. The client had no ideas during the interview on how the LbD model could be developed, but he was interested in learning more about it. The customer thinks that the LbD model is best suited for group and project work.

VI. CONCLUSIONS

The research strategy of this study is action research and has many different phases, which is typical of action research. The primary purpose of action research is to develop the practices of the target organisation under study, which in this study are related to the development of teaching practices. Three educational organisations are involved in the study. This article describes the research done in the fall of 2020-21 and 2021-22 in the RGU.

The LbD approach would be well-suited to a project-based learning module involving a working life project. According to the students, the LbD model is suitable for studying computing science because students think that LbD appropriately combines theory and its application in practice, which deepens competence. However, a couple of students believe that there are also challenges in the LbD approach, and more in-depth knowledge of the LbD principles would be needed. Students' experiences of the LbD approach were generally positive, with a few exceptions. Many students also felt that their skills had developed in several different areas during the study module, reinforcing the notion that LbD is also well suited as a learning method for students in

computing. Issues related to competence development were derived from Laurea's 2030 strategy. They were therefore wide-ranging, so some of the areas of expertise included in it are also those that are not directly included in the objectives of the Software Engineering study module.

The lecturer's experiences were also largely positive. The lecturer thinks that the LbD approach is well suited to the study program in Software Engineering and as a learning method for computer science studies. However, the lecturer believes that the LbD approach is not suitable for all studies and requires a good orientation and commitment and understanding of the requirements of the LbD.

The client's experiences of participating in such a collaborative project according to the LbD action model, in which students, lecturers and clients participate in working life projects, were positive. The customer also felt that she had received a valuable return on the projects, which she could utilise directly or develop further. The students' views also added value and "out of the box" thinking to the customers. However, the customer believes that the LbD model may not be suitable for all students, as it requires a great deal of initiative and the ability of students to adapt to new situations.

The following research cycle will be conducted in Finland at a different higher education institution than the first. Important information is collected from all three universities on how suitable the LbD model is for computing science studies and the students' experiences of applying it. The pilot study at RGU aims to determine whether computer science students can successfully use the LbD outside Finland, where the LbD model has been developed. While work is still ongoing to understand the impact of LbD, initial results from staff and clients are very positive. A broader perspective needs to be gathered and understood so that a suitable framework for students might be proposed.

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