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FROM A STUDENT TO A RESEARCH ASSISTANT – STUDENT'S PROFESSIONAL GROWTH IN RESEARCH AND DEVELOPMENT

Abstract:

Häme University of Applied Sciences´ (HAMK) projects are in line with the profiles of the research units and provide opportunities for students to participate in applied research. Integration of teaching and R&D operations develops skills needed in working life. The goal of this article is to describe using examples Häme University of Applied Sciences´ (later: HAMK) electrical and automation technology students´ possible road from a student to research assistant and to showcase the experiences of a few assistants in their professional growth.
Students' views were found out using a survey. Based on the answers HAMK's electrical and automation studies´ current operations have created successful work experience and motivating path towards applied studies. In addition, it has helped them of their professional growth, professional profile and future career expectations.
Electrical and automation studies´ students have a clear path towards becoming a member of the research community. As the activity stabilizes, this path can be brought to students as one of their career opportunities. It is a viable option for those seeking a career in R&D, but it is also suitable for those who consider research capabilities to promote their careers in other businesses.

Keywords:

Promotion of studies, professional growth, pedagogy, team teaching, quality management.

JEL Classification: I21, I23, I29

1 Introduction

Tasks of Häme University of Applied Sciences´ (later: HAMK) include education, applied education and development its area. In development projects tasks often merge. Projects have students in variable numbers in different roles: learners, trainees, thesis makers and assistants. Some of the students grow to become full members of the applied research group through project activities.

The goal of this article is to describe electrical and automation technology students´ possible road from a student to research assistant and to showcase the experiences of a few assistants in their professional growth. Chapter 2 describes the HAMK-level pedagogical and research bases. Then, in Chapter 3, we look at the subject by mirroring it with changes in working life competence. Chapter 4 combines the perspectives of the two previous chapters by examining HAMK's assistant paths for electrical and automation technology, followed by a survey done to assistants in Chapter 5. The last chapter 6 summarizes the conclusions.

2 HAMK’s framework

2.1 Strategy

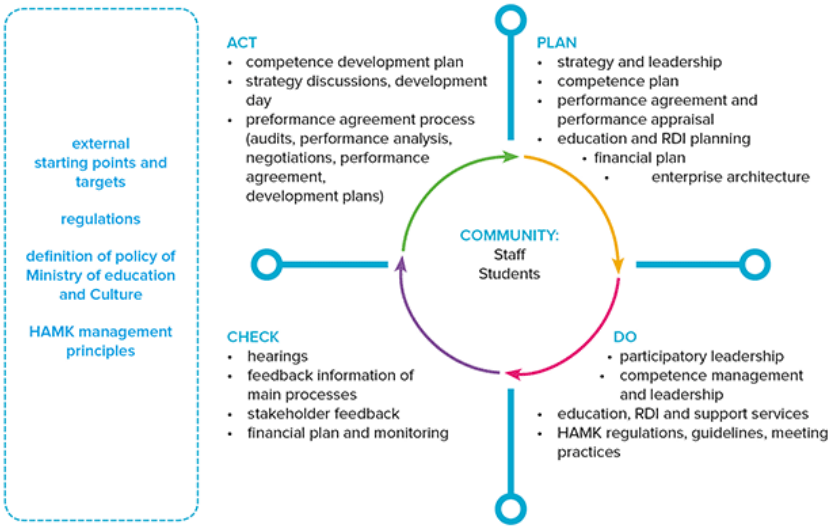
The vision of HAMK is to be the most inspiring, the most workplace-oriented. “HAMK is an internationally and nationally networked higher education institution that is committed to its partnerships. HAMK graduates are desired experts in the labour market; they are global problem-solvers with a creative and progressive approach. Our applied research generates vitality, sustainability and wellbeing. HAMK effectively utilizes the possibilities offered by technology in improving the quality and performance of education and research.” *(HAMK, n.d.a)*

2.2 Pedagogic model

HAMK's pedagogic model is based on modules and working in teams. Instead of individual discrete courses, the lessons are designed for 15 credit modules, where a phenomenon is viewed from different perspectives. Common materials such as communications or language studies are integrated into a module. Thus, for example, there are no separate “own” tasks for learning communication skills. Instead of that, written reports are combined to a module-wide practice task. Learning goals are defined, but the team can decide the pedagogical methods to gain the targets.

Teachers work in teams which helps them to cope with constant changes. It also helps to try different pedagogical solutions. In the Electrical and Automation Engineering degree programme team teaching is practice as usual. Many years of development work has created a culture where teams have the ability to test different pedagogical methods. Trust in working and experimenting together is created through joint planning and collaboration. The development circle on which HAMK's quality management is based on (Fig. 1) is a central approach. The team responsible for the module designs, implements, evaluates and develops its operations according to it. When both design and implementation are done together, it is easy to openly evaluate and develop implementation together. This creates a circle of trust.

Figure 1: HAMK's Quality System



Source: Key quality management procedures and documents (HAMK, n.d.b).

The changes in working life require that electrical and automation engineers have skills to participate in project works. Experts of a certain field in working life no longer work alone. Essential part of work nowadays is the collaboration of the team and successful completion of the project and not the success of an individual. The readiness for this type of activity is to be established already during the studies. Studying in a project-like manner starts right at the beginning of the studies. The first module is a small-scale project. Technical skills are practiced, but the main objectives are studying project activities, teamwork and communication, as well as language studies. Gradually, during the studies, the projects will deepen to meet the needs and methods of working life. It is essential that learning is based on the basis of the knowledge learned. Information acquisition skills and source criticism are guided throughout the studies.

2.3 Branching career paths

HAMK uses an operating model of proficiency and management development. According to vice-principal Heidi Ahokallio-Leppälä's dissertation, individual freedom and self-direction are the basis for the ability to manage competence and to fit different expectations together. This means that the individual's tasks in relation to the strategy are not so much resource-based but from the perspective of the development of an individual. Individuals are given the freedom to develop their own work methods. In this way, resource-based strategic thinking and personal development that promotes individual development are combined. Educational organizations must approach the culture of innovative companies and create opportunities for diverse career paths for the staff. *(Ahokallio-Leppälä, 2016)*

Integrating the strategic functions of the university - education and applied research - will also create

paths for developing skills for students.

2.4 Applied research activities

Company co operations, where assignment from companies are often done, are an important for student learning and regional impact. Some companies collaborate in projects with universities, so that they can get to know and recruit students that suit them. Co operations are also important for students on getting an introduction to working life and employment. Teachers also benefit from collaborations: they stay up to date and have a chance to update their skills and teaching. Representatives of working life get pedagogical professionals to direct development project that students implement.

Universities also do deeper applied research. This is divided into four categories in HAMK. One of these is HAMK Tech, Technology for the future. It includes the following research groups: Energy efficiency; Robotics; Materials; Steel structures; 3D technologies; Long term durability. Students participate in research group activities as part of their studies and during work practice and thesis.

3 Theoretical background

3.1 Skills of the future

Creation of new knowledge is a skill of a future professional. Educational organisations need to educate professionals that do not only manage their current work but can also create new things.

Present and future generations must search for answers for so called wicked problems, for example global warming. Solutions must be thought globally, not only based on own country's best interests. Technical innovations and skills on engineers will have a more significant role in future. Engineers professional requirements grow and so called meta skills rise to an important role. These are also called soft skills in literature.

Improvements in robotics and machine vision provide opportunities to solving global problems, but they need the right knowledge and creative development. Essential skills according to British innovation foundation Nesta and University of Oxford are for example, judgement and decision making, fluency of ideas, active learning, learning strategies and originality. *(Bakhshi, Downing, Osborne & Schneider, 2017)* This requires constant change and development. It is not a static state but a process.

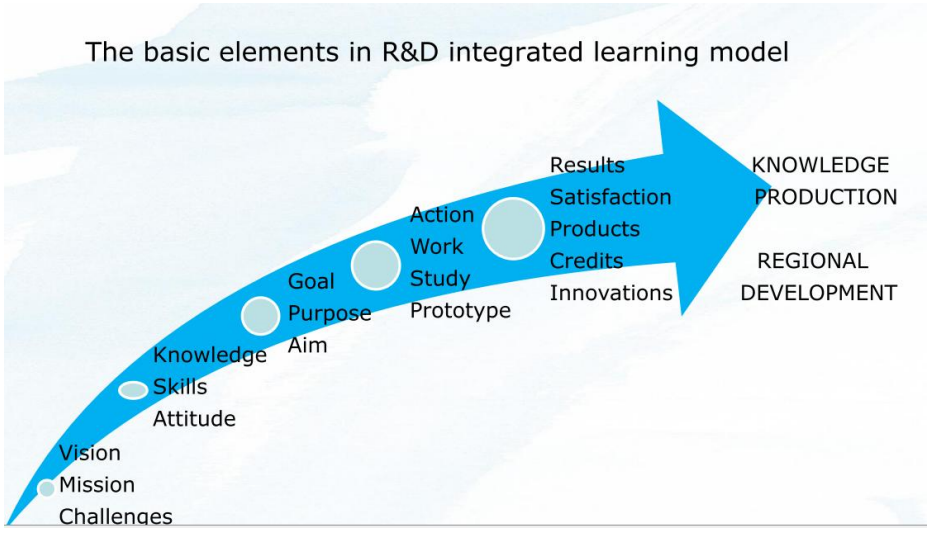
Expertise and competence assessment 2021 made by the Technology Industries of Finland 2018 brings up the following general skills needed in working life: ability to see possibilities, efficient use of ICT, preparedness for constant learning, comprehension of the whole, conceptual skills, attitude, understanding of clients' point of view, teamwork skills and preparedness to act on multicultural community. *(Karikorpi, 2019)*

3.2 Professional growth with integration of R&D activities

Research and development activities in universities offer a possibility to bind learning to be part of research activities. R&D integrated learning model introduced by Ilkka Väänänen (PhD, research director at the Innovation Centre in the multidisciplinary Lahti University of Applied Science) and Sirpa

Laitinen-Väänänen (PhD, principal lecturer at the Teacher Education College in Jyväskylä University of Applied Sciences) combines learning and R&D activities that were though as separate previously (Fig. 2). According to them it is at the same time challenging and motivating for students because it brings a new touch and variety to theoretical studies and combines different professional competencies. It also challenges the teacher to develop his/her own R&D skills and leads teaching towards student-oriented learning. *(Väänänen & Laitinen-Väänänen, 2011)*

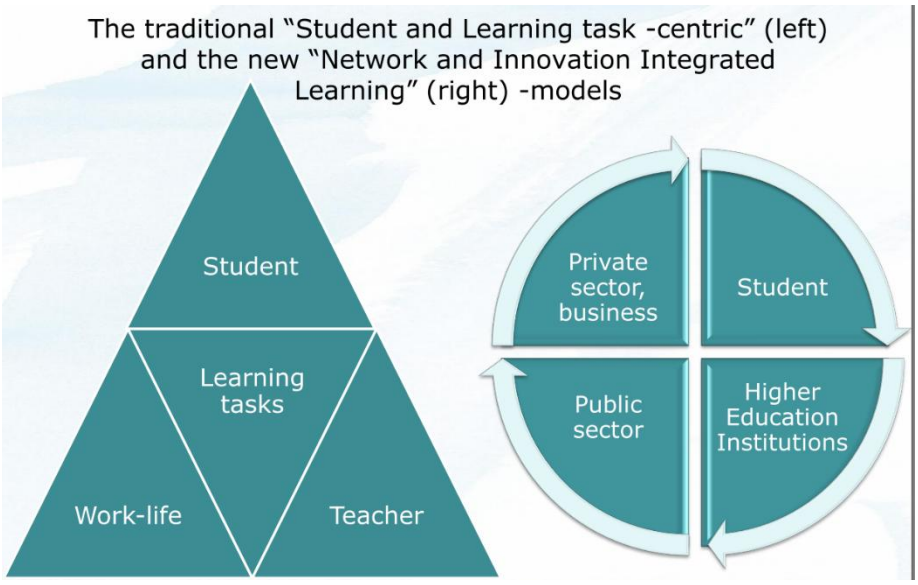
Figure 2: The basic elements in R&D integrated learning model



Source: Väänänen & Laitinen-Väänänen, 2011

Väänänen & Laitinen-Väänänen introduce their way of thinking in figure 3. In traditional thinking the situation is as described in the left triangle. Student is at the centre, but different roles have distinct boundaries. In the cyclical model on the right there is a clear change concept and approach. Student is an equal factor with the others in an ecosystem that increases creativity and innovation. *(Väänänen & Laitinen-Väänänen, 2011)*

Figure 3: The traditional "Student and Learning task -centric" (left) and the new "Network and Innovation Integrated Learning" (right) -models



Source: Väänänen & Laitinen-Väänänen, 2011

4 From a student to a member of the research community

4.1 From a student to an assistant

What methods in HAMK's training in Electrical and Automation Technology degree programme promote students' participation in applied research and development? How does it promote the development of the student's professional growth and professional competence? What are the students´ opinions on the matter?

The example described in chapter 2.4 illustrates the potential of an applied research and development project for different levels of integration of students into R&D. A bond may form from the slightest of integrations of teaching and projects; it can be very useful for all parties.

Some students take a path leading to becoming a member of the applied research community. Typically, at first it progresses in a way that the student participates in module projects within the framework of normal teaching. The first projects goals are mainly aimed at learning meta-skills. The most important of these are teamwork, project learning and communication skills.

As the studies progress and skills become more advanced, moving more extensive and demanding study-related projects required. At this stage, the student will usually find out at the latest whether he/she is particularly interested in development projects. Students have the opportunity to apply for project activities, for example in summer work. They can also complete a partial or full-time internship of 30 credits or 20 weeks. However, the majority of student assistants start working in development

projects while studying. In general, the project activity is started on average during the third year of study. Near the end of the studies there is a thesis (15 cr). After completing their training in development projects, as a natural continuum, the student thesis is usually related to development projects. As it shows up in a figure 2, students skills accumulate by the research and development activities by step by step.

4.2 Becoming an expert

A clear transition to the path described above arises when the student completes his degree. Usually at this stage some students decide to apply for a job in a company while some focus on doing a master's degree. Some will continue in HAMK's R&D, perhaps while making their master's degree. At this point, their titles usually change, and their responsibilities increase.

Upon graduating, students will be transfer in projects from assistants to the role of project engineers. This means, among other things, that they guide new student assistants in their work. Initially, they will be given smaller sub-assemblies as responsibility. As skills increase, some of them are given project manager's tasks, and some will deepen their knowledge in one of the specialized areas.

HAMK has a strong culture of development and the staff is encouraged to continuous learning. Maybe that's why many former students have grown to become real experts.

4.3 An example of a development project

In Energy efficiency by optimized control -project (later: TOE -project), the teaching and research activities were largely combined by following the model described in chapter 3.2. The aim of the project was to promote energy efficiency. During the project, existing means of producing, storing and utilizing energy were surveyed and new possibilities for increasing energy efficiency were explored. Low carbon usage was the main theme of the project. The main focus of the development work was the physical modular building, the hybrid module (Fig. 4). It was designed as a pilot for optimal use of different energy sources. The module is used not only in research but also in teaching, as it can be used to illustrate the process of control technology optimization and applications of renewable energy.

Figure 4: Hybrid Module

Source: Architect picture by Juuso Horelli (2017)

Some students were deeply involved in the core of development, for example building intelligent control systems. The students who drew up the control system grew up to be key research assistants, who not only developed the activity, but also provided information about it. In this way, they acquired skills needed in working life, such as working in an international group, project management, English and communication.

In total, the project involved students from six different degree programmes. The actual construction phase of the hybrid module was done by a multidisciplinary group of students from five different nationalities. Their role was not research-based, but they also got an idea of what kind of research framework their work and learning were related to. This can also be seen as adding to their understanding of applied research, improving their ability to work with a developing approach in their own work and increasing their meta-skills described in chapter 3.1.

5 Survey

5.1 Basic information

A survey was made asking about professional growth and the effect on advancement of studies to students taking part in research activities to develop operations. It was carried out in spring 2019 and it was sent to current and previous students of Electrical and Automation Engineering programme that were taking part in research projects at the time.

The survey was sent to six research assistants / project engineers and five of them answered. Survey was conducted by Webropol-web tool and respondents answered anonymously. The following questions were asked: How did you get involved in the project work? How long have you been involved in project activities? How did the project contribute to your professional growth? How be involved in the project, promoted your studies? What have you learned from research work? What have you learned from research work?

5.1 Results and analysis of the survey

How did you get involved in the project work?

Importance of teachers has been great for many respondents. Of course, the students' activity also had a decisive role. Then again teachers notice students that are active and suitable for research activities and encourage them to participate.

Examples of answers:

> I got involved with project working when I was looking for summer jobs. First, I tried to apply as summer studied assistant but then there was good position to attend in project working and field which was very interesting after summer I continued part time as project worker same time continuing my studies.
>
> I have participated meetings and was actively involved in the project equipment selection. Some of my ideas has been taking in to account and possibly will be implemented in the project.
>
> Teachers observed my academic performance and offered me chance to work in a project.
>
> I started to ask teachers for additional project, so I could finish some courses faster or without exams. Later I was offered to participate in more serious research projects.
>
> I was teaching myself how to do web programming when one of the projects at the moment was in need of such a programmer. The project was TOE, and I was assigned as a student assistant.

How long have you been involved in project activities?

The respondents have been typically taking part in projects for 1-2 years. Based on experience few years is a typical time of involvement in these types of projects. After those the assistants usually move on to different development positions, transfer to work in companies or continue their studies towards master's degree.

How did the project contribute to your professional growth?

Two different points of view get highlighted in the answers: they have more profound knowledge of subject and in turn they have developed their soft skills like project management, problem solving, communication skills and social networking.

Examples of answers:

Project contribute have improved my knowledge more than my studies combined. Also I have got knowledge in the field which wasn't my main studies at the courses which I'm doing full time right now.

The project gives me an opportunity to be involved in the complex decision-making process. Seeing the ideas are developing from the theoretical stage to the hardware level helping me to create more solid idea about R&D.

Vastly in both professional and networking aspects

I've got new both technical and communication skills, practical experience. In the end I've got a full- time job offer to participate in research projects.

Participating in different projects, I was able to gain various connections to different people from many professions related to my career. It also provided a good experience base for my future jobs.

How be involved in the project, promoted your studies?

It has benefitted the thesis and gained deeper knowledge of software usage. Participating to the project has also significantly improved their learning methods. Students have been able to complete part of their studies in research projects and that has advanced their studies and brought up new studying skills.

Examples of answers:

Involved in the project working have promoted my studies with bachelor's thesis work which help me to finish the degree. Also, project working has improved my thinking on studies and which are the interesting things in my field of knowledge. Before project working I didn’t have any knowledge of things which my daily work in these days are.

The methods, that was used in the project also being handy in my studies. In fact, learning some principles of the modeling and hardware selection in the project, puts me ahead in my studies

One project ended up providing me a thesis topic and further my skill in a discipline that is different from my major

Project work allowed to skip some assignments or even whole courses. But even when I had to fully participate in some course, it was very easy due to practical experience form the projects.

The projects provided great opportunities for practicing textbook knowledge in real life situation. In addition, I was able to achieve many skills outside of the industrial automation sector, such as software programming, software deployment & management, 3D design, etc.

What have you learned from research work?

Students have learned that it is not enough to just do good research or development work; you also must know how to share knowledge. Communication skills get highlighted. Problem solving skills were also highlighted in these answers.

Examples of answers:

> I have learnt from the research work that even if the topic which you are researching is not so important there is still someone who might be interested on same topic. Important is to make sure that somehow the research outcome need to be published and shared.
>
> The research work is very complex and difficult to plan process. It is a very difference from, for example, production process in many aspects. The main difficulty is in the research work: It is nearly impossible to predict the outcome of the hypotheses, before most of the work is actually done.
>
> That research results are not only new value, but also applying academic research results in practical areas
>
> How to write good reports, technical documentation. Bunch of technical skills: math, programming, general design, etc.
>
> The most important thing I learned from the research work is the skill of problem-solving.

Do you feel that you have willingness and the ability to work with the applied research?

Every respondent had a positive attitude on participating in research in the future. Importance of motivation was highlighted. Applicability and pragmatism of research got highlighted in the answers. This is natural when research matches the profile of the university.

Examples of the answers:

> Applied research is thing which I'm doing fully at this moment, so I'm very keen that I can do applied research, it fits my working style a lot.
>
> Absolutely yes. The applied research, in my opinion, is one of the most interesting fields of the engendering. It is very complex, challenging and none-repetitive. The willingness comes from the motivation, and motivation is very deepening on how interesting job i'm doing.
>
> I feel that willingness. However, it depends a lot on a nature of the project. If I can not see any actual research in some project, then motivation disappears.
>
> As I would like to continue a higher level study, a good applied research background would be a great contribution.

6 Conclusions

The purpose of the article was to describe how R&D projects are operation in accordance with university profile and what kind of opportunities they offer to electrical and automation students to participate in R&D. Another purpose was to describe what kind of skills can develop by integrating R&D and learning.

It can be noted that R&D offers student different levels of learning opportunities. Those that do not participate in actual applied research also get an understanding of R&D and process of forming new knowledge. They also develop essential skills needed in the future working life.

Purpose was also to describe by example the path of student becoming research assistant in HAMK and to introduce their experiences about their growth as professionals. Examples concern HAMK's Electrical and Automation Engineering programme's student assistants that have step by step moved to work in Energy efficiency -research group and their opinions can not be generalized to other research group assistants. Number of answers is also small and that also narrows the possibility of generalization. Answers do provide basic information to be a basis for future improvements.

It can be seen that electrical and automation engineering students have a clear path from student to becoming part of applied research cooperation group. When operations stabilize, it can be brought up to students as a possible career option. Its only suitable for some, but considerable possibility for those that seek career in R&D. It is also suitable for those that see that research experience might further their career.

Answers indicate that HAMKs Electrical and Automation Engineering programme's current operations have created successful work experience and motivating way towards more profound applied research. It has also helped them to gain a more profound understanding about their professional growth, professional profile and future career expectations.

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