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Academic Practice Abroad: a Case Study of Hochschule Wismar and the HEPS in Tarnów*

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The emergence of Higher Education Professional Schools (HEPS) in Poland, which were established in line with the *Reform of National Education*, has largely changed the Polish higher education sector. Apart from the universities, which offer two levels of education, the HEPSs have been established to offer the first level of education leading to the award of the title of Bachelor or Engineer. One of the most important points in engineering curricula is internship. The last semester (seventh or eighth) is dedicated to long internship, diploma work and diploma thesis preparation. In the article, the authors present tangible results coming from the cooperation agreement between Hochschule Wismar - University of Technology, Business and Design (HSW), Wismar, Germany, and the state Higher Education Professional School (HEPS) in Tarnów, Poland, in the field of practical training and diploma work; this has been facilitated by the framework of international cooperation that was developed and promoted by the UNESCO International Centre for Engineering Education (UICEE). In particular, the overall bilateral collaborative programme, as well as some specific examples, are presented and discussed in this article.

INTRODUCTION

Higher Education Professional Schools (HEPS) in Poland are relatively new higher education institutions, whose mission is to educate students at the Bachelor level. In the case of technical studies, the education process leads to the award of the title of Engineer. The creation of the HEPSs should be seen in a bigger picture that is in the context of the radical reform of the Polish education system, especially as it relates to the Bologna Declaration, which was signed in 1999 [1]. The first schools of this type (completely new in the Polish education system) were established in May 1998. One of these schools is the HEPS in Tarnów.

The law and subsequent regulations governing these schools are based on the existing European and international laws and regulations that have been put in place in order to make higher professional education more connected to industry and the community [2-7]. Moreover, the legislative approach undertaken was to

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make the programme structure more comparable and compatible with those in the countries of the European Union (EU), as well as other countries in Europe and beyond [2][5].

ENGINEERING EDUCATION AT THE HEPS IN TARNÓW

Comprehensive studies have been carried out in order to identify critical issues in the development of the curricula for studies in the Polytechnic Institute at the HEPS in Tarnów.

Thorough discussions and research work were carried out in order to devise, analyse and introduce a system of quality control, including the quality of the selection of candidates to the studies in the engineering courses. The outcome of this work was the introduction of a new system of recruitment and enrolment of students [1][6-9].

In addition, as a result of comprehensive observations and analysis of the system, some changes were introduced into the system in 2001-2004. These changes concern the organisation of the study system, entrance examinations (optional type of enrolment – up to the students), as well as extending the course by one semester, to make the course slightly longer (four years) and in line with the Bologna model.

In the academic year 2003/2004, there were almost 5,000 students enrolled in the courses provided by the HEPS in Tarnów. The Polytechnic Institute caters for over 30% of the students who presently study in various engineering specialisations. The most popular specialisation at the HEPS in Tarnów is *Applied Informatics*, where normally almost three persons apply for one placement every year. The second most popular specialisation is *Electrics with Electronics*, and the third one, and so far the less attractive speciality for potential candidates, is *Technology of Materials*. The latter speciality did not commence its operation in the first year because of the inadequate number of candidates.

In Poland, undergraduate studies (full-time regular courses at state universities or other institutions) do not attract any tuition fees. Students who experience difficult economical conditions can receive financial support from the State, such as scholarships, reduced payment for student housing, etc. Housing near higher education institutions is very popular because students can still have support from home and do not need to travel. Most students at the HEPS in Tarnów stay at home with their families and thus spend less money for their travel to and from the University.

It should be pointed out that students in Poland normally commence their education after finishing a secondary school education institution of any kind. At the time of completion of their secondary education, most students are aged 19. With the dual system of engineering education in Poland (ie one leading to the award of the title of Bachelor and the other leading to the award of the degree of Master), the courses at the Polytechnic Institute fall into the first category.

Moreover, the degree programmes at state Higher Education Professional Schools are heavily oriented towards practical applications in order to satisfy the requirements made by trade and industry organisations. An internship (external practice and training) semester has been introduced, which forms an integral part of all the programmes. The general structure of the study programme in the engineering courses at the HEPS in Tarnów is presented in Table 1.

The last semester is devoted mainly to the preparation of the diploma thesis and the internship, where most students prepare diploma theses during their stay in industry or enterprise. Because of this, diploma work is not only theoretical but also more practical, which is essential for the future professional career of those engineers graduating from the HEPS in Tarnów.

Generally, graduates of Higher Education Professional Schools are viewed as being well prepared for their professional activities and there is a great demand for such qualified personnel, especially in small and medium-sized enterprises in Poland. However, due to the collapse of several companies, resulting from the economic restructure, there is growing unemployment; this is quite a significant problem for those countries in economic transition.

Table 1: The structure of the study programme in engineering courses at the HEPS in Tarnów, Poland.

First Year of study	Second Year of study	Third Year of study	Fourth Year of study
Foundation Courses		Advanced Courses	
Scientific and engineering fundamentals.	Engineering fundamentals. Compulsory subjects within the chosen area of specialisation. Short internship in an industrial organisation for four weeks.	Compulsory subjects within the chosen area of specialisation.	Industrial training (long-term internship) of five months. + Diploma Thesis

It has been observed that university graduates are the biggest group of unemployed persons in Poland (44% in 1998). This is very critical as unemployment is a persistent problem in Poland, with the overall unemployment rate of 10.6% in 1998, and over 20% in the first part of 2003.

RELATIONSHIP WITH HOCHSCHULE WISMAR

Collaboration with Hochschule Wismar - University of Technology, Business and Design (HSW), Wismar, Germany, which the authors regard as fruitful, commenced in 1999 due to the efforts of the Director of the UNESCO International Centre for Engineering Education (UICEE), Prof. Zenon J. Pudlowski, the then Dean of the Faculty of Mechanical, Process and Environmental Engineering at the HSW, Prof. Norbert Grünwald (presently Rector of the HSW), and the then Vice-Rector for Development at the HEPS in Tarnów and the Director of its Polytechnic Institute, Prof. Stanisław A. Mitkowski. The two representatives of the institutions in question were both very much interested in establishing international cooperation programmes, particularly industrial practices abroad.

The initial period of the involvement in collaboration between the two academic institutions was dedicated to a comparison of the study systems, curricula and syllabi in order to establish the best plan for the exchange of students and staff and to determine possible fields for collaboration.

This work, as well as extensive visits between the two institutions, led to the formulation and signing of a *University Cooperation Agreement*, which was later much more simplified and signed in 2003. The signing of these documents enabled the institutions to establish close bilateral cooperation.

POLISH STUDENTS' DIPLOMA WORK AT THE HSW

In the academic year 2001/2002, the first group of Polish students took part in the International Quality Network (IQN) programme, carried out at the HSW. Three students from the *Electrics with Electronics* specialisation (Polytechnic Institute) and one student of *Mathematics with Informatics* (Natural Sciences Institute) left Poland for Germany in October 2001.

For four months (regarded as a long internship), these students were involved in the preparation of their diploma work and the diploma theses at the *Gottlob Frege Centre for Engineering Science and Design* (GFC), a satellite centre of the UICEE based at the HSW. Prof. W. Schauer and Dr G. Sauerbier, both of the HSW, acted as the coordinators of the students' activities.

Because of the excellent level of supervision at the HSW, all the students involved prepared good diploma work that was highly evaluated and assessed by the Polish and German examiners. The work prepared under the auspices of the Gottlob Frege Centre, and the specifics of the IQN international project by Polish students from Tarnów, are presented in Table 2.

Table 2: Diploma work undertaken by the Polish students (HEPS in Tarnów) at Hochschule Wismar for the period from 2000-2004.

Study Area*	Diploma Thesis Title	Type of Work
E	Uberwachung und Remote Control in der Gebaudeautomation	Experimental and analytical
E (2)	Control of an Experimental Transportation System by Process Coupled Simulation	Experimental and analytical
M	Mathematical Integral Calculus Using *WebCT*	Applied (as e-learning course)
I	Comparison of Automation Systems *WinCC* and ProTool/Pro	Experimental and analytical
I	Comparison of Automation Systems Hardware and Software PLC	Experimental and analytical
E (2)	State-Based Modelling of Control Strategies and Automatic Code Generation for Mobile Robots	Experimental and analytical
M	Design of a Teaching Unit Differential Calculus for a Multimedia Course on the Internet	Applied (as e-learning course)
E	Computer-Based Training System for Basic Circuits of Power Electronics DC System	Applied (as e-learning course)
I	Computer-Based Training System for Basic Circuits of Power Electronics AC Systems	Applied (as e- learning course)
E	Integration of 3D Positioning Units in an Industrial Robot System	Experimental and analytical
I	*Matlab* Toolbox for Kuka Robot Remote Control	Experimental and analytical
M	Design of a Teaching Unit Lagrange Multiplier Method	Applied (as e-learning course)

*E - Electrical with Electronics, I – Applied Informatics, M – Mathematics (HEPS in Tarnów)

The first of the diploma works mentioned above was entitled: *Uberwachung und Remote Control in der Gebaudeautomation*. The main objective of the work was the comparison and application of camera systems that were controlled via the Internet. The second project, titled *Control of an Experimental Transportation System by Process Coupled Simulation*, was dedicated to the construction of a model and the comparison of the applicable control systems.

Another group of students also experimented with automation systems based on certain devices (programming tools and controllers), which were produced by the German company, Siemens. Students had to construct in the laboratory such models as a press, a lift and a mobile robot. They had to solve problems related to the manual construction and sensors assembly, and then carry out work regarding the programming of sensors, as well as conduct a comparison of different automation programs or systems.

Moreover, relevant educational systems were also created for teaching purposes, utilising the *ToolBook II* programming package. This presented the automation systems and methods of programming used.

In the academic year 2003/2004, some experimental diploma work was also carried out. Students undertook experimental work in the robotics laboratory at Hochschule Wismar. The main element of the system under study was an industrial robot (KR3 by Kuka company). This robot was complemented with several sensors in order to support calibration, process control and diagnostics. The process-coupled simulation methods are planned to be used for system control. Figure 1 shows some of the students with an industrial robot.

Figure 1: Students with an industrial robot.

The main steps carried out by the Polish students for the laboratory work development were as follows:

- Preparation of 3D positioning units to work together with the industrial robot;
- Control of the *Kuka* robot through the serial port;
- Use of the *Matlab* package so as to control the various functions of the robot's motion, establish functions to set up the parameters of the robot (eg velocity), set up functions to obtain the parameters from the controller (eg the actual positioning of the arms), etc.

During the last four years, 14 persons from the HEPS in Tarnów prepared and completed their diploma work while at the HSW. It should be pointed out, with regret, that only one female student from Tarnów was in this group. However, the work she undertook in mathematics was assessed as excellent.

Most of the projects carried out in Wismar had a more experimental than theoretical character; where students usually had to prepare an experimental model and carry out the analysis of its functions (eg development of specific test control programme). It was intended that the applied diploma work would be mostly applicable, for instance in the e-learning courses (parts) or educational materials utilised by the two institutions.

It should be mentioned at this point that the students involved were very much satisfied with their work. In their view, the possibility of expanding their knowledge by learning new techniques and technologies was extremely fruitful for their future professional engagements. Anecdotal evidence indicates that most of the graduates use the knowledge and skills attained during their training at the HSW in their present job.

THE FIELDS OF POSSIBLE FUTURE COLLABORATION

It should be noted that the students' mobility project came first. At present, the two academic institutions cooperate under the European programme, Leonardo da Vinci, which is dedicated to teacher training and the exchange of experience in engineering education, and also under the educational and cultural student exchange programmes (SOCRATES programme, DAAD and Jugendaustausch), conferences, seminars and publications. Discussions and negotiations are being presently carried out between the two institutions concerning new fields and ways of collaboration; for example, programmes such as Equal, Erasmus Mundus, TEMPUS, etc, are being examined.

SOME FACTS ABOUT THE HSW, GFC AND IQN

Engineering education in Wismar was founded in 1908. Hochschule Wismar, in its present form as a University of Technology, Business and Design, has existed since 1992. Behind the background of almost 100 years of engineering education, this young University seeks modern educational methods in engineering sciences. Key strategies cover internationality, and interdisciplinary focus and the utilisation of modern technologies.

In the winter semester of 2003/2004, the HSW had, in total, 4,141 students, with 2,007 of them engaged in engineering study courses [10]. The structure of the engineering study programme covers a two-year foundation course (basics) and a two-year advanced course, which is similar to the HEPS in Tarnów, Poland.

The Gottlob Frege Centre (GFC) was founded in 2000 and became a UICEE satellite centre engaged in engineering science and design in 2001 [11]. By using key strategies consistently, the GFC was able to carry out the DAAD (German Academic Exchange Service) International Quality Network (IQN) programme. Within the framework of this programme, 34 students from international Partner universities of the HSW studied in Wismar between September 2001 and July 2004, mostly for five months. Under supervision from staff at the HSW and their home university, all of these students were involved in research projects at the HSW. The 14 projects of the students from the HEPS in Tarnów demonstrated an excellent professional level, as most of them were practical and applied projects and used modern technologies.

The common judgement of the supervisors in Wismar for the Tarnów students included the following key characteristics:

- Excellent performance;
- High motivation;
- Independent work;
- Politeness;
- Clear and well-structured reports written at an excellent level of the English or German language.

CONCLUSIONS

The established collaborative programme presented here, involving a period of study abroad at the Gottlob Frege Centre in Wismar, Germany, indicates the high achievements of the Polish students from the HEPS in Tarnów.

It should be pointed out that the Polish students have had the opportunity to carry out their diploma projects at the HSW because of the existence of the international collaborative network established under the auspices of the UICEE.

Since 2001, 14 Polish undergraduate students have prepared their diploma work at the HSW in such fields as mathematics, sciences, electrics with electronics, as well as informatics sciences. All the theses were judged highly by both the Polish and German academic examiners.

The bilateral collaboration between the academic institutions in Tarnów and Wismar concentrates primarily on the internationalisation of the science foundation in higher education. Furthermore, it also serves to enhance the understanding of basic concepts and principles of engineering and mathematics through collaborative work, as well as develop scientific education that is properly founded and application oriented.

The specific collaborative programme includes such particular activities as engineering diploma work (scholarships for Polish students to study abroad), teachers and academic staff study visits, educational and cultural exchanges, teacher training and mobility, as well as cooperative conferences, seminars and meetings.

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All of the skills and professional experiences that the Polish students acquired during the training at the HSW, would have not been possible without the intensive work of German supervisors, such as: Prof Dr Winfried Schauer, Prof. Dr Thorsten Pawletta, Prof. Dr Sven Pawletta and, in the last year, Prof. Dr Hans-Peter Dunow. It should also be acknowledged that Prof. Dr Dieter Schott, the Co-Director of the *Gottlob Frege Centre for Engineering Science and Design* (GFC), a satellite centre of the UICEE at the HSW, supervised all the diploma work and theses dedicated to applied mathematics.

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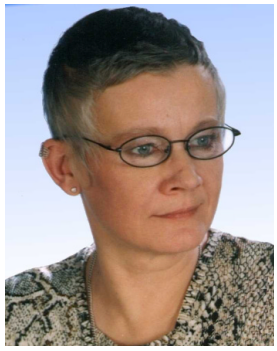
BIOGRAPHIES

Dr Agnieszka Lisowska-Lis (PhD) is a biologist in the Polytechnic Institute at the Higher Education Professional School (HEPS) in Tarnów. During the period from 1989 to 1995, she studied in the Department of Animal Biology and Husbandry at the Agricultural Academy in Kraków, finishing her MSc in animal physiology. She also undertook additional studies in biochemistry, endocrinology and zoology in the Biology Department at Jagiellonian University in Kraków; as well as short course at the Scottish Agricultural College, Auchincruive, UK, with diploma work on *Milk malabsorptions and allergies*.

After completing her studies, she worked for one year in the Animal Breed and Breeding Department at the Animal Husbandry Institute in Balice. That work was dedicated to freezing animal embryos. Her PhD study was carried out from 1997 to 2001 and focused on waste utilisation, as well as educational works in the ecological background of the Environmental Engineering Department and the Animal Biology and Husbandry Department at the Agricultural Academy in Kraków.

She is a member of the Engineers Association in Poland (NOT), the Polish Ecological Club and the Malopolska Ornithological Association.

She is presently engaged in tutoring and lecturing to engineering students (*Electrics with Electronics* and *Technology of Materials*) at the HEPS in Tarnów. The courses are dedicated to wide aspects of ecology in modern engineering. Since 2000, she has been involved with the Polytechnic Institute at the HEPS in Tarnów, being responsible for international projects involving student and staff mobility, thematic projects, and institutional networks.



Ms Elżbieta Wojciechowska is a graduate of the Faculty of Materials Engineering and Ceramics at the University of Mining and Metallurgy (UM&M) in Kraków, Poland.

From 1981 to 1997, she worked at the UM&M as an administrative officer in the Studies Department. In her position, she was also one of the key organisers of the *Walery Goetl* School of Environmental Engineering and Protection, established at the UM&M.

Since 1997, she has been engaged in the organisation of the Higher Education Professional School (HEPS) in Tarnów where, since 1998, she has been delegated to work in the Polytechnic Institute as the Manager of the Office of the Director.

Also, she has been involved in the activities of the UICEE through its international linkages, notably with Hochschule Wismar – University of Technology, Business and Design, Wismar, Germany, and is a great supporter of the UICEE, particularly through her

work at the Polytechnic Institute at the HEPS, with the Institute being a Contributing Member of the UICEE.

For her longstanding commitment and valued work for the Polish higher education sector, she was awarded the Silver Cross of Merit in 2003.

Stanisław A. Mitkowski was born on 13 December 1944 in Kraków, Poland. He completed high school education at the 5th High School *Witkowski* in Kraków in 1962, and commenced his studies in the Faculty of Electrical Engineering at the University of Mining and Metallurgy (UM&M), Kraków, graduating Master of Engineering (Electrical) in 1968. He obtained a PhD and DSc (Doctor Habil) from the same University in 1974 and 1989, respectively. He has been with the UM&M since 1968, initially as an assistant, and, since 1992, as a Professor. He has held a number of important positions, including that of the Vice-Rector (Science) between 1990 and 1996, and he has been Head of the Department of Theoretical Electrotechnics since 1993. He is an Honorary Professor of the National Mining Academy of Ukraine, Dnepropetrovsk, Ukraine.

Prof. Mitkowski also held the position of Vice-Rector for Development at the HEPS in Tarnów, and is Director of its Polytechnic Institute.

His research interests include circuit theory, in particular non-linear electric circuits, and engineering education. He has published extensively on these subjects in national and international journals and conference proceedings.

Prof. Mitkowski is Vice-President of the National Council of the Polish Society of Theoretical and Applied Electrotechnics, a member of the Branch of Theory of Electrotechnics of the Committee for Electrotechnics within the Polish Academy of Sciences, a member of the IEEE, a member of the Society of Polish Electrical Engineers, and a member of several other national and international organisations. Since 2002, Prof. Mitkowski has been a member of the State Accreditation Commission (SAC) in Poland.

He is an active member of the UICEE, and received the UICEE Silver Badge of Honour for his achievements in engineering education in 1998.

Prof. Mitkowski is also a passionate stamp-collector and the Vice-Chairman of the Kraków Branch of the Society of Polish Philatelists.

Zenon Jan Pudlowski graduated Master of Electrical Engineering from the Academy of Mining and Metallurgy (Kraków, Poland), and Doctor of Philosophy from Jagiellonian University (Kraków), in 1968 and 1979 respectively. From 1969 to 1976, he was a lecturer in the Institute of Technology within the University of Pedagogy (Kraków). Between 1976 and 1979, he was a researcher at the Institute of Vocational Education (Warsaw), and from 1979 to 1981, was an Adjunct Professor at the Institute of Pedogogy within Jagiellonian University. From 1981 to 1993, he was with the Department of Electrical Engineering at The University of Sydney where, in recent years, he was a Senior Lecturer.

He is presently Professor and Director of the UNESCO International Centre for Engineering Education (UICEE) in the Faculty of Engineering at Monash University, Clayton, Melbourne, Australia. He was Associate Dean (Engineering Education) of the Faculty of Engineering between 1994 and 1998. His achievements to date have been published in more than 300 works, including books, manuals and scientific papers in refereed journals and conference proceedings.

In 1992, he was instrumental in establishing an International Faculty of Engineering at the Technical University of Lodz, Poland, of which he was the Foundation Dean and Professor (in absentia) (1992-1999). He was also appointed Honorary Dean of the English Engineering Faculty at the Donetsk National Technical University (DonNTU) in the Ukraine in 1995.

Professor Pudlowski is a Fellow of the Institution of Engineers, Australia, and of the World Innovation Foundation (WIF). He is a member of the editorial advisory boards of many international journals. He was the 1st Vice-President and Executive Director of the AAEE and the Editor-in-Chief of the AJEE since its inception in 1989 until 1997. Currently he is the Editor-in-Chief of the *Global Journal of Engineering Education*, and is the Foundation Secretary of the International Liaison Group for Engineering Education (ILG-EE).

Professor Pudlowski has chaired and organised many international conferences and meetings. He received the inaugural AAEE Medal for Distinguished Contributions to Engineering Education (Australasia) in 1991 and was awarded the Order of the Egyptian Syndicate of Engineers *for Contributions to the*

Development of Engineering Education on both National and International Levels in 1994.

In June 1996, Professor Pudlowski received an honorary doctorate from the Donetsk National Technical University in the Ukraine in recognition of his contributions to international engineering education, and in July 1998 he was awarded an honorary Doctorate of Technology from Glasgow Caledonian University, Glasgow, Scotland, UK. In 1997, he was elected a member of the Ukrainian Academy of Engineering Sciences. In 2002, he was awarded the title of an Honorary Professor of the Tomsk Polytechnic University, Tomsk, Russia, and was appointed an External Professor at Aalborg University, Aalborg, Denmark.

Norbert Grünwald was born in Rostock, Germany, on 5 October 1953. He studied mathematics at the University of Rostock, receiving the degree of Bachelor of Mathematics in 1979, and was awarded a doctorate, specialising in discrete mathematics, in 1984. Between 1984 and 1986, he was on the scientific staff of Deutsche Seereederei Rostock, a shipping line, before working as a scientific assistant in the Institute of Mathematics of the Warnemünde/Wustrow Maritime Academy.

In 1991, he took up a scientific assistant position in the Department of Mathematics of the University of Rostock, and since 1992, he has been Professor of Mathematics and Operations Research in the Department of Mechanical Engineering at Hochschule Wismar - University of Technology, Business and Design, Wismar, Germany, where he is actively involved in the self-government of the institution. From 1998 until 2002, he was the Dean of Mechanical Engineering/Process and Environmental Engineering and was elected Rector of Hochschule Wismar in September 2002.

Professor Dr Grünwald has published several works, various conference papers and journal articles, as well as has becoming involved in a number of research projects and expert reports. He is a coordinator and jury member of the German Mathematical Olympiad, and is a member of Deutscher Mathematiker-Vereinigung e.V. and Mathematikolympiaden e.V. Prof. Grünwald is also a member of the Accreditation Commission of the Accreditation Agency for Study Courses in Engineering, Informatics and Natural Sciences (ASIIN).

On the international front, he is a member of the International Liaison Group for Engineering Education (ILG-EE), and of the UICEE Academic Advisory Committee, of which he is a Deputy Chairman. He is also a Co-Director of the *Gottlob Frege Centre for Engineering Science and Design*, a satellite centre of the UICEE.

He was awarded the UICEE Silver Badge of Honour for Distinguished Contributions to Engineering Education in 1998, and the UICEE Gold Badge of Honour was conferred upon him during the *2nd Global Congress on Engineering Eduation*, held in Wismar in 2000.