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Integration of AI Training in the Field of Higher Education in the Republic of Bulgaria: An Overview

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Abstract: The presented work provides a comprehensive evaluation of the current availability of education programs and courses related to of AI the field of Information Technologies and Computer Science in higher education institutions (HIEs) in the Republic of Bulgaria. More specifically, this study examines 163 bachelor's and 239 master's degree programs from 28 HEIs available during the 2023/24 academic year in four professional fields: (1) Electrical Engineering, Electronics, and Automation; (2) Communication and Computer Technologies; (3) Informatics and Computer Science; and (4) Mathematics. The conducted evaluation shows that 41.1% of evaluated BSc programs and 26.4% of MSc programs include at least one AI-dedicated course. Results indicate a significant presence of AI-focused education, particularly in degrees related to Informatics and Computer Science, where 47.8% of AI courses are concentrated. However, a notable disparity exists in the inclusion of AI subjects across other technical fields, particularly in Electrical Engineering and related degrees, which contain only 8% of the identified AI courses for BSc degree programs. The findings highlight the need for a broader and more accelerated integration of AI education to meet the evolving demands of both students and the labor market. This work underscores the importance of strategic curriculum adaptation to enhance the readiness of Bulgarian HEIs to support the development and application of AI technologies, addressing the skills gap and fostering a workforce capable of navigating the AI-driven future.

Keywords: higher education; artificial intelligence education; curriculum integration; Information Technologies; Computer Science; AI training in Bulgaria; technological workforce development

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1. Introduction

The rapid advent of AI-based systems and technologies is driving change in all societal spheres—industrial, economic, and cultural [1,2]. The extent of the capabilities of modern AI systems is still being studied and their implementation is expected to have a revolutionary effect for a wide array of businesses, both small and large [3]. In many cases, their adoption can lead to improvements in effectiveness, productivity, sustainability, and cost reductions. In the opposite case, an inability to adapt to the new realities and advancements in the field of AI may lead to a drastic decline in an enterprise's competitiveness and its subsequent failure [4].

Although it is traditionally accepted that technological advancements lead to increases in productivity and serve as a driver for increases in the demand for labor, wages, and

employment and result in economic growth [5–7], their introduction is not always a key factor for development [8,9] and can have a detrimental effect on employment [10–12]. Studies on the effects of implementation of AI-based systems in businesses [13,14] show that the increase of productivity and effectiveness comes as a result of the reconfiguration of the organization's processes around AI and not through its direct implementation in their current environment. These findings suggest that with the increase in the use of AI systems and tools, and their introduction to a broader range of fields, a significant reorganization of enterprises will occur, which will in turn cause shifts in the structure and nature of the job market [15–17]. The predicted structural changes in the labor market are already observable, with the demand for AI expertise having the highest increase among the skillsets required for IT occupations [18].

In that regard, many countries around the world are developing or have already prepared legislative frameworks regarding the implementation of AI [19–23]. One of the consistently highlighted key elements for successful and stable integration of AI into the economy is the existence of an adequately trained and skilled workforce [22,24]. Although different national policies set different goals for the development and introduction of AI technologies [25], most of them highly prioritize the training of AI experts [26]. In line with this goal, specialized curriculums and initiatives for education in AI are being developed and integrated in middle schools and high schools in China [27], South Korea [28], India [29], Australia [30], the EU [31], and the USA [32].

In the Republic of Bulgaria, the national strategy for the development and implementation of AI technologies in the economy is outlined in a number of key documents, among which are the European White Paper on Artificial Intelligence [33], the Ministry of Transport and Communication's Concept for the development of AI [34], the Ministry of Education and Science's outline on "Artificial Intelligence in Education and Science" [35], and the Strategy for the Development of Artificial Intelligence in Bulgaria until 2030 [36], among others. In the field of higher education, it is proposed that a larger number of students should be trained and specialized in the field of Artificial Intelligence. The approaches for achieving these goals are through the creation of dedicated AI degrees, as well as the expansion of the curriculums of courses in the professional fields of Communication and Computer Technologies and Informatics and Computer Science. The outline published by the Ministry of Education and Science suggests that curriculums in the fields related to AI should be modified in two ways: (1) By the inclusion of broader subjects dedicated to the study of mathematics, logic, algorithmic, and programming skills related to AI, and (2) with specialized courses dedicated to the study of state-of-the-art technologies in the field of AI and the acquisition of skills related to the creation of specialized novel AI systems and architectures. Furthermore, the strategies define three main types of sectors that create and use AI: sectors developing AI; AI-consuming sectors; and sectors creating conditions for the development and implementation of AI. Universities, with their activity, are practically involved in all three types of sectors—they provide an environment in which knowledge about AI is developed, they consume AI in their research and teaching activities, and they solve scientific and applied problems related to the implementation of AI for the needs of business and society, thereby contributing to improving the competitiveness of the economy and improving the standard of living. This reveals the importance of universities in the development, consumption, and application of AI for the economic life of the country.

Unfortunately, this significance is not reflected in the relevant scientific studies and their published results. There are publications by Bulgarian authors who discuss the application of AI in higher education, emphasizing its legal regulation and the relevant ethical norms, without affecting the dullness of the study of AI in curricula and programs of Bulgarian universities [37], while others emphasize the application of AI in the education of students, aiming for its intensive entry into the educational process from 2023 [38]. One of the main areas of interest for universities regarding AI technologies is the opportunity for their integration in administrative processes, such as interactive student recruitment,

improving administrative procedures and support, personalization of interaction, and access to digitalized resources [39,40]. Another highlighted field of significant interest is the implementation of AI as a part of the education process, both in regards to the presentation of information as well as being part of an interactive learning process. In relation to higher education, the developed strategies [33–36] outline a wide number of areas of impact and specific measures that affect the creation of knowledge and skills for the development and use of AI in higher education, including the training of a large number of bachelor's degree students, expanding and intensifying training in AI, the creation and maintenance of programs for talents and outstanding students, building skills related to data analysis and AI, updating university education programs, studying the impact of AI on society as well as standards for reliable AI, and using AI in university management. However, at the current moment, no empirical data and scientific research regarding the current state of AI education in higher education institutions (HEIs) in the Republic of Bulgaria are available, which creates objective difficulties and problems with the measurements of the progress in the implementation of the strategies and tracking the development and application of AI. These problems result in fundamental obstacles for carrying out any research in the field of evaluation of the application and development of AI in and through higher education in Bulgaria. From here, the main research questions of the current work can be defined as follows:

RQ1: What is the level of inclusion of AI-related teaching in Bulgarian universities in the field of Computer Science and Information Technology?

RQ2: To what degree does AI-related education affect students currently pursuing a BSc and MSc degree in the field of Computer Science and Information Technology?

Obtaining answers to the presented questions based on quantitative empirical data will provide the basis for future research that will reveal the dynamics, robustness, and development of AI in Bulgarian universities.

2. Literary Review

The main purpose of the conducted study is to present a quantitative estimation of the level of inclusion of AI-related education in HEIs in the Republic of Bulgaria for fields related to Computer Science and Information Technology. This study covers bachelor's degree (BSc) and master's degree (MSc) programs, and evaluates two main factors: the number of AI-dedicated degree programs and the number of AI-related courses included in the degrees.

In its essence, Artificial Intelligence is a broad scientific field encompassing the creation of algorithms, software tools, platforms, and machines which can interpret data, generate autonomous responses, and interact with their surrounding environment [41,42]. The genesis of AI systems can be traced back to the 1950s when the first neural computer was created and the term "Artificial Intelligence" was introduced. After this, AI has gone through cyclical periods of development and growth, accompanied by high expectations about its wide adoption, followed by decreases in interest due to its practical performance and capabilities [43]. In the last decade, with the rapid increase of computational power, as well as the emergence of "Big Data" driven by modern capabilities for the collection of data and creation of databases [44,45], AI has begun to reach the potential that has been expected and envisioned in the past decades. Currently, along with the Internet of Things (IoT), cloud computing, and analytics, AI has become a key part of Industry 4.0 [46,47] and, alongside its traditional applications in the IT sector, is finding rapid adoption in a varied range of contemporary industries and fields [48], such as technology [49,50], healthcare [51,52], education [53,54], finance [55,56], and even art [57]. It is expected that the current advancements observed in AI technologies will only accelerate [58,59] and permeate everyday life. This expectation raises questions regarding the capability of HEIs to answer to the demands of both students and the labor market in regards to training in the field of AI.

When the evaluation of higher education degree programs is considered, traditionally, a holistic approach is taken. Existing evaluation methodologies [60,61] are based on a multifaceted examination of the cohesion of the combined courses with the aim of estimating the overall effectiveness of the learning process. Such studies are complex and must take into account a wide number of factors such as educational philosophy, objectives, teaching and learning materials, teaching and learning approach, and student satisfaction and acquired skills [62]. As a result, such studies evaluate each course included in a given degree program based on its relation with the remaining courses in that program.

In regards to the quantitative analysis of higher education, the used approach is, again, targeted towards a larger scale evaluation of the universities on institutional level [63,64]. In these cases, universities are being evaluated based on a large number of parameters in a wide range of categories, including general information, revenues, expenditures, personnel, education production, and research and innovation, amongst others. This evaluation approach creates a data-based parametrical representation of universities which allows the overall performance of HEIs to be monitored, compared, and ranked. Similarly structured benchmarking-based degree program evaluation methodologies are well established and used in higher education review and scoring procedures in many countries [65–67]. One of the main challenges that this strategy poses is the gathering of uniform and consistent data [68].

Studies on the inclusion of AI in higher education curriculums vary between different countries and areas. In many developed countries, there has been a sustained effort towards the inclusion of AI-related education in curriculums [69,70]. For developing countries, the subject is not well studied and a limited number of studies exists [71]. In the case of the European Union (EU), studies regarding the inclusion and adoption of courses related to upcoming technological paradigms (such as Industry 4.0) are often focused on single countries [72,73] or a small group of countries [74]. Additionally, with the rapid advent of sophisticated generative language models (such as ChatGPT [75,76]) in the last year, the research focus has strongly shifted from training in AI towards the inclusion and use of AI for education [77–80].

In [70], Dec et al. conduct a study on the inclusion of AI subjects in degree programs as part of a wider study on the adoption of subjects related to Industry 4.0 (Artificial Intelligence, the Internet of Things, and Edge Computing). The methodology of the study includes two approaches towards the estimation of the level of inclusion of AI courses in HEI degree programs: assessment of university training programs and surveys of academic teachers. In the first case the degree programs of universities from four countries were evaluated—Poland, Spain, Greece, and Italy. A total of 26 bachelor's degree and 38 master's degree programs were analyzed, with total of 64 courses identified, 78% of which were dedicated to AI. In regards to the conducted survey, a total of 144 academics participated, of which 86 reported that they teach courses related to Industry 4.0. From the further surveyed group of eighty-six participants, only three people were from Bulgaria, with no information on the distribution of the answers in relation to country of origin being provided for the survey. Another detailed study on the inclusion of AI education in HEIs is presented by Lashayo and Mhina [71]. The study focuses on 10 HEIs in Tanzania, and it is based on a survey to academic personnel from the examined HEIs. The study covers a wide range of programs—from technician and certification courses to master's degree programs. From the examined HEIs, 10 offer BSc degree programs and 5 MSc degree programs. Both types of degree program include an average of three AI-related modules for each institution.

Based on the analyzed sources, a significant number of studies on the evaluation of the curriculums of higher education institutions exist. These studies are, however, predominantly aimed towards analyzing degree programs as a complex structure and do not focus on the evaluation and comparison of single components of the analyzed programs. Furthermore, studies evaluating the presence of specific courses or the educational focus of a degree program towards certain technological or industrial aspects tend to cover larger countries which are industrial or business centers. This is especially true for the field of AI,

which is already having a strong effect on the structure of business enterprises and labor markets around the world. As such, the evaluation of the capacity of the higher education systems of different countries to meet the arising challenges, and the strategies they adopt to do so, becomes even more important for both national and international development.

3. Methodology

The presented study is conducted on the basis of the developed theoretical model presented in Figure 1.

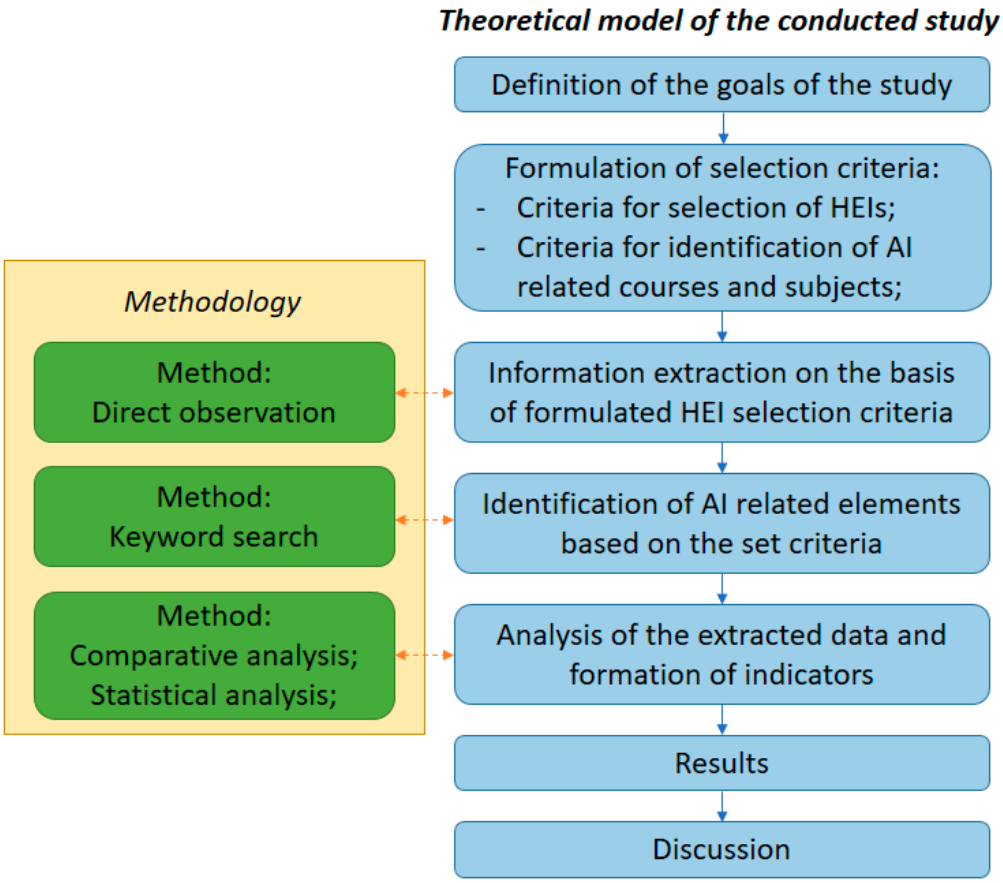

Figure 1. Theoretical model of the conducted study.

The adopted methodology consists of three main steps:

1. Formulation of selection criteria;
2. Data collection;
3. Data analysis.

This framework is selected as it allows for a standardized approach in the evaluation of specific areas of interest which are part of the higher education in a given country or a group of countries. During the first step, the criteria in regard to the goals and scope of the conducted evaluation are set. These criteria may be related to a field or subject of interest, the number and type of HEIs which will be included in the study, and the area which the study will cover—specific regions in a country, an entire country, or a group of countries. After the criteria are defined, data collection is carried out. The information is gathered based on direct extraction from publicly available sources. During the last step, the collected data are analyzed using standard statistical techniques or more advanced data mining algorithms. A major consideration during the definition of the presented framework is the possibility for the automation of individual stages or the entire process of evaluation. For that purpose, the data collection and processing conducted during the different stages

are based on fixed criteria. The data collection procedure is based on keyword searches, and the extracted data—such as degree program, semester of the courses and electability—are universal for all HEIs. The processing is carried out both on per university basis as well as for all universities and includes the calculation of mean values or ratios of distribution for the collected data. Similarly to the data collection stage, the conducted processing is uniform for all examined institutions.

4. Materials and Methods

The following section discusses the details of each step of the proposed methodology used for the current study.

4.1. Formulation of Selection Criteria

The conducted examination aims to evaluate the level of integration of AI training in the curriculums of BSc and MSc degrees in higher education institutions in the Republic of Bulgaria for fields related to Information Technologies. In the current work, the following categorization convention has been used: the terms "degree" and "degree programs" indicate a full BSc or MSc program, while the term "courses" denotes semester-long units which make up the degree program.

For the evaluation, the following four professional fields are selected: (1) Electrical Engineering, Electronics, and Automation; (2) Communication and Computer Technologies; (3) Informatics and Computer Science; and (4) Mathematics. These fields are chosen as each of them covers a significant part of the different aspects of modern AI systems—algorithm creation, the creation of computer systems and software products based on AI, and the implementation of such algorithms and systems in either specialized or consumer devices. These professional fields, as defined above, are part of the classification of the professional fields utilized by the Bulgarian Ministry of Education and Science as well as scientific institutions and HEIs in Bulgaria, and cover degree programs with similar subjects and thematic scope. The selected professional fields are denoted in accordance with the standard classification system by using the codes assigned to each field. Both the names of the fields and their respective codes are used interchangeably when referenced further in the text:

1. Electrical Engineering, Electronics, and Automation, (Field code: 5.2).
2. Communication and Computer Technologies, (Field code: 5.3).
3. Informatics and Computer Science, (Field code: 4.6).
4. Mathematics, (Field code: 4.5).

The universities examined in the current study are selected based on their inclusion in the Bulgarian university ranking system (also abbreviated as BURS further in the text) [81] in each of the examined professional fields.

For inclusion in the ranking system, each university must have a government accreditation for the specific professional fields in which it is offering courses. Each accredited field of a university is scored separately, with the final score being calculated using a wide range of different indicators, grouped into six categories, namely (1) teaching and learning; (2) science and research; (3) teaching and learning environment; (4) welfare and administrative services; (5) prestige; and (6) career relevance to labor market and regional importance. The ratings are calculated on a yearly basis and reflect the development, importance, and impact of each university on a national scale and, more specifically, score the provided education in different professional fields.

The selection criterion of the universities included in the study is based on the ranking presented in BURS. More specifically, all universities included in rankings for the four selected fields are examined. This approach is selected as it allows for a detailed evaluation of the currently available curriculums in the examined professional fields. Furthermore, in the current work, the BURS rankings are taken under consideration, as in the Bulgarian national context the BURS system is used during the evaluation and budgeting of HEIs. As

such, data regarding the total number of students attending a degree program in a given field for different universities are also taken from the BURS.

The criterion chosen for the identification of the AI-related degree program and courses is based on keyword searches. Degree programs are defined as "AI-dedicated degree programs" if the name of the degree implicitly states that it is related to AI (e.g., "Artificial Intelligence" or "Artificial Intelligence and data processing"). Similarly, the curriculums of offered degree programs are analyzed of the presence of keywords, including "Intelligence", "Artificial Intelligence", "Computer Intelligence", "Neural networks", and "Machine learning". Courses with a strong relation to the field of AI but with no additional clarifications are omitted (e.g., "Data mining" or "Intelligent systems"). This approach is taken as in a large number of HEIs the information about the precise subjects constituting a course is not openly provided. In cases where such information is available and the inclusion of AI topics in the contents of the subject can be verified, these subjects are accounted for in the study. Due to the applied selection criteria, this study tends to cover more subjects that are strongly dedicated to AI topics and, as a result, presents a more conservative estimation on the level of integration of AI subjects and their availability.

4.2. Information Extraction on the Basis of the Formulated HEI Selection Criteria

Based on the ranking of the BURS for the four selected professional fields (Table 1), a total of 28 unique institutions are selected for the study. It must be noted that positions in the ranking system can be shared in cases where two or more universities have equal score.

Table 1. University rankings for four professional scientific fields for 2023 as per the Bulgarian university ranking system.

Position	University	Score
Professional field 5.2: Electrical Engineering, Electronics, and Automation		
1	Technical University of Sofia	67
2	University of Chemical Technology and Metallurgy	59
3	"Georgi Benkovski" Bulgarian Air Force Academy	56
3	Higher School of Transport "Todor Kableshkov"	56
3	"Angel Kanchev" University of Ruse	56
3	Technical University of Varna	56
3	University of Food Technologies	56
4	University of Mining and Geology "St. Ivan Rilski"	53
5	Technical University of Gabrovo	52
6	"Paisii Hilendarski" University of Plovdiv	51
7	Trakia University Stara Zagora	49
8	Burgas Free University	48
8	"Prof. Dr. Asen Zlatarov" University-Burgas	48
9	South-West University "Neofit Rilski"	46
-	Medical University Varna "Prof. Dr. Paraskev Stoyanov"	na
Professional field 5.3: Communication and Computer Technologies		
1	Technical University of Sofia	72
2	Sofia University "St. Kliment Ohridski"	64
3	"Nikola Vaptsarov" Naval Academy	59
4	Technical University of Varna	57
5	National Military University "Vasil Levski"	56
6	New Bulgarian University	54
7	Higher School of Transport "Todor Kableshkov"	53
8	University of Telecommunications and Posts	51
8	"Angel Kanchev" University of Ruse	51
9	Burgas Free University	50
10	"Paisii Hilendarski" University of Plovdiv	49
11	Technical University of Gabrovo	48
11	University of Food Technologies	48
11	South-West University "Neofit Rilski"	48

Table 1. *Cont.*

Position	University	Score
12	"Prof. Dr. Asen Zlatarov" University-Burgas	44
12	"Konstantin Preslavsky" University of Shumen	44
-	Trakia University Stara Zagora	na
	Professional field 4.6: Informatics and Computer Science	
1	Sofia University "St. Kliment Ohridski"	75
2	American University in Bulgaria	67
2	Technical University of Sofia	67
3	New Bulgarian University	59
4	University of Library Studies and Information Technologies	57
5	"Paisii Hilendarski" University of Plovdiv	55
6	University of Veliko Turnovo "St. Cyril and St. Methodius"	53
7	Burgas Free University	52
7	Varna Free University "Chernorizets Hrabar"	52
8	University of Economics–Varna	51
9	"Angel Kanchev" University of Ruse	50
10	South-West University "Neofit Rilski"	46
11	"Konstantin Preslavsky" University of Shumen	44
-	Trakia University Stara Zagora	na
-	Varna University of Management	na
-	European Polytechnical University	na
	Professional field 4.5: Mathematics	
1	Sofia University "St. Kliment Ohridski"	72
2	Technical University of Sofia	61
3	"Paisii Hilendarski" University of Plovdiv	54
4	"Konstantin Preslavsky" University of Shumen	53
5	"Angel Kanchev" University of Ruse	48
-	American University in Bulgaria	na
-	University of Veliko Turnovo "St. Cyril and St. Methodius"	na
-	South-West University "Neofit Rilski"	na

na—not applicable.

In certain cases, some universities are included in the list of HEIs for a given professional field but are not ranked. This occurs when the degree programs in a given professional field are recently introduced in a university and accredited, but currently there is not a sufficient amount of data for a score to be calculated. As the lack of score—and the subsequent ranking—is a result of the technological process of the BURS and is not reflective of technical or administrative issues in a given HEI, unranked universities are not excluded from the current study. Additionally, the ranking system is not a direct indicator for the quality of the offered education in different professional fields of universities, as the final score is derived using up to 100 different indicators and the ranking may vary in accordance to the weights attributed to specific criteria by users of the system. In this regard, Table 2 presents information about the accreditation score of the universities included in the current study granted by the Bulgarian National Evaluation and Accreditation Agency [82]. The table contains information about the accreditation score of each accredited professional field in the examined universities, as well as the overall accreditation score of the HEIs. In addition to Table 2, Figure 2 presents the relation between the universities ranks for different professional fields and the accreditation score of the universities for the given field. Universities included in the rankings for the various professional fields but not yet assigned a rank are not included in the graphs.

Table 2. Accreditation scores for professional fields and overall institutional accreditation scores for the HEIs included in the study.

University	PF5.2	PF5.3	PF4.5	PF4.6	Inst.
Technical University of Sofia (TUS)	9.48	9.58	9.44	9.16	9.56
Sofia University "St. Kliment Ohridski" (SU)	-	8.45	9.62	9.67	9.61
Technical University of Varna (TUV)	9.39	9.27	-	-	9.31
Technical University of Gabrovo (TUG)	9.26	9.14	-	-	9.08
"Angel Kanchev" University of Ruse (UR)	9.38	9.36	9.37	9.34	9.44
"Nikola Vaptsarov" Naval Academy (NA)	-	8.88	-	-	9.59
"Paisii Hilendarski" University of Plovdiv (UP)	9.04	9.12	9.54	9.24	9.39
New Bulgarian University (NBU)	-	9.11	-	9.26	9.00
University of Library Studies and Information Technologies (ULSIT)	-	-	-	9.02	9.33
American University in Bulgaria (AUB)	-	-	9.38	9.19	9.09
University of Chemical Technology and Metallurgy (UCTM)	9.19	-	-	-	9.38
"Konstantin Preslavsky" University of Shumen (US)	-	9.06	9.2	9.23	9.12
Trakia University Stara Zagora (TU)	9.1	4.00	-	4.00	9.20
Higher School of Transport "Todor Kableshkov" (HST)	9.17	9.19	-	-	9.10
University of Food Technologies (UFT)	9.20	9.24	-	-	9.33
South-West University "Neofit Rilski" (SWU)	8.87	9.08	9.10	9.01	9.30
University of Veliko Turnovo "St. Cyril and St. Methodius" (UVT)	-	-	8.58	9.10	9.45
Medical University Varna "Prof. Dr. Paraskev Stoyanov" (MUV)	8.99	-	-	-	9.27
European Polytechnical University (EPU)	-	-	-	8.12	6.49
Varna University of Management (VUM)	-	-	-	9.08	8.51
University of Economics–Varna (UEV)	-	-	-	9.12	9.28
Varna Free University "Chernorizets Hrabar" (VFU)	-	-	-	8.94	9.21
Burgas Free University (BFU)	8.91	9.24	-	9.01	9.03
University of Telecommunications and Posts (UTP)	-	8.84	-	-	8.56
National Military University "Vasil Levski" (NMU)	9.02	-	-	-	9.15
University of Mining and Geology "St. Ivan Rilski" (UMG)	9.08	9.26	-	-	8.84
Georgi Benkovski" Bulgarian Air Force Academy (BAFA)	-	9.09	-	-	9.19
"Prof. Dr. Asen Zlatarov" University–Burgas (UB)	9.18	-	-	-	9.01

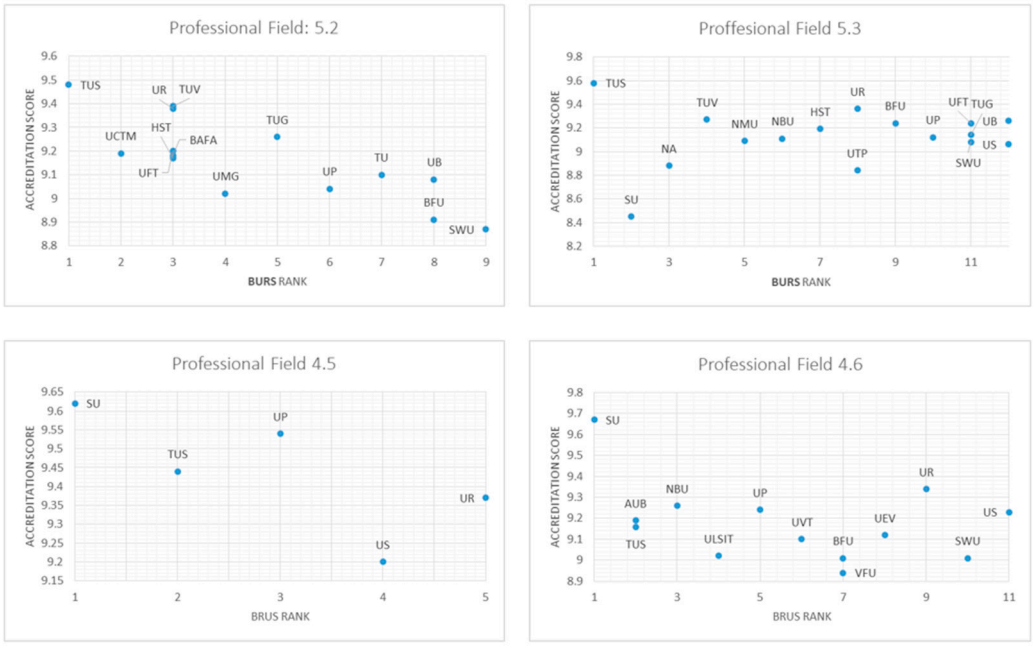

Figure 2. Relation between professional field accreditation score and rank in the Bulgarian university ranking system for different professional fields (Note: Unscored universities included in the ranking are not shown on the figures).

The analysis of the degree programs and courses offered by these universities is conducted based on the publicly available information (current degree programs and curriculums of the offered degrees) provided by the universities on their websites. In addition to the degree programs available in the universities themselves, degree programs available in branches of the universities in locations different than the one where the university is based are also examined, as they are part of the overall structure of the institution and, as such, are included in its BURS scoring and accreditation. Specifically, the curriculums of all listed BSc and MSc degrees are analyzed, including both degree programs available for new students during the academic 2023/2024 year as well as degree programs that are listed but are not offered during the academic 2023/2024 year. This study covers only the newest curriculums and does not take into account older curriculums, where available. Additionally, the evaluation also only focuses on courses offered in Bulgarian and master degree programs with a length of 1.5 years in cases where options for degrees with varying lengths are present. This criterion is applied as 2.5-year MSc degree programs are designed for students with BSc degrees from fields different than the one of the MSc degree program, and cover the last year of a thematically adjacent BSc degree program. However, cases in which a university offers only master's degree programs with a duration over 1.5 years are taken into account and included in the study.

4.3. Identification of AI-Related Elements Based on the Set Criteria

An evaluation on the availability of AI courses and degree programs in the selected universities is carried out based on the selected keywords. The evaluation covers all bachelor and master degree programs in the four professional fields of interest for each university included in the study. It must be noted that the conducted curriculum analysis excludes course projects and term papers. Traditionally, curriculums include semester-long tasks which are graded separately and form a dedicated course (course projects) or are part of a course and are included in the score for the subject (a coursework or term paper). The exclusion of course projects and term papers from the study is done as the information regarding them is often included in the subject curriculum and, as a result, is not evenly accessible for all examined HEIs.

4.4. Analysis of the Extracted Data and Formation of Indicators

For each of the identified AI degree programs, the following data are extracted: professional field and degree level (BSc or MSc). The extracted information for the dedicated AI courses is as follows: professional field, degree level (BSc or MSc), semester in which it is offered, and availability (compulsory, elective, or facultative). The collected data are analyzed using two methodological approaches: comparative analysis and statistical evaluation. The conducted comparative analysis evaluates the offered degree programs between HEIs in terms of the professional field of each degree and its courses. The courses included are analyzed based on the accredited professional field of the degree program in which they are offered and the number of AI subjects included in the courses. The statistical analysis of the AI subjects covers the overall percentage of availability of AI subjects in the BSc and MSc degrees, the ratios between elective and compulsory courses, the ratios between professional fields, and the average semester in which they are offered, amongst other parameters. Additionally, the relations between the AI-related training and the number of students attending the degree programs in the professional fields of interest are examined.

5. Results

The conducted evaluation covers a total of 163 bachelor's degree programs and 239 master's degree programs. The results obtained from the analysis of the contents of the BSc programs are presented in Table 3, where the first column lists the universities included in the study. The second column of the table contains the total number BSc programs offered in the universities in the four examined professional fields, while the third

column contains the number of BSc programs which include courses on AI. The fourth column lists the number of BSc programs which are dedicated to AI. The fifth column indicates the number of BSc programs containing more than one AI course. The last column lists the percentage of BSc programs which incorporate AI courses for the given university.

Table 3. Overview of BSc degree programs containing AI courses and AI-dedicated BSc programs for examined universities.

University	Total Number of BSc	BSc with AI Dedic. Course	AI Dedic. BSc	BSc with >1 AI Course	BSc with AI Course
Technical University of Sofia	20	11	2 */**	4	55.0%
Sofia University "St. Kliment Ohridski"	10	6	0	3	60.0%
Technical University of Varna	13	5	1	1	38.5%
Technical University of Gabrovo	6	2	0	1	33.3%
"Angel Kanchev" University of Ruse	10	5	0	0	50.0%
"Nikola Vaptsarov" Naval Academy	5	3	1	2	60.0%
"Paisii Hilendarski" University of Plovdiv	16	1	0	0	6.3%
New Bulgarian University	4	3	1**	0	75.0%
University of Library Studies and Information Technologies	5	3	0	2	60.0%
American University in Bulgaria	3	0	0	0	0%
University of Chemical Technology and Metallurgy	2	2	0	0	100.0%
"Konstantin Preslavsky" University of Shumen	12	5	0	0	41.7%
Trakia University Stara Zagora	5	2	0	0	40.0%
Higher School of Transport "Todor Kableshkov"	6	0	0	0	0%
University of Food Technologies	2	0	0	0	0%
South-West University "Neofit Rilski"	7	2	0	0	28.6%
University of Veliko Turnovo "St. Cyril and St. Methodius"	5	4	0	1	80.0%
Medical University Varna "Prof. Dr. Paraskev Stoyanov"	1	1	0	0	100.0%
European Polytechnical University	1	1	0	0	100.0%
Varna University of Management ***	1	1	0	0	100.0%
University of Economics–Varna	3	2	0	1	66.7%
Varna Free University "Chernorizets Hrabar"	1	1	0	0	100.0%
Burgas Free University	4	1	0	0	25.0%
University of Telecommunications and Posts	7	4	0	2	57.1%
University of Mining and Geology "St. Ivan Rilski"	2	0	0	0	0%
"Prof. Dr. Asen Zlatarov" University-Burgas	4	2	0	0	50.0%
National Military University "Vasil Levski" ***	3	na	0	na	na
Georgi Benkovski" Bulgarian Air Force Academy ****	5	na	0	na	na
Total:	163	64	5	17	41.1%

* One of the bachelor's degrees is accredited in professional field 5.13: General Engineering. ** An offered bachelor's degree course includes an option for specialization in the field of AI. *** The offered degree course has a reduced length of 3 years. **** Curriculums for the offered degrees are not publicly available. na—not applicable.

The results of the conducted study show that there are currently five AI-dedicated bachelor's degree programs available in Bulgarian HEIs. Two of the programs are offered by the Technical University of Sofia, while the Technical University of Varna, New Bulgarian University, and "Nikola Vaptsarov" Naval Academy have one available AI-dedicated degree program. However, it must be noted that one of the degree programs offered in the Technical University of Sofia is accredited in professional field 5.13: General Engineering, which lies outside the currently examined four professional fields. Degree programs in this field are generally not targeted towards a single engineering field, but are instead designed to cover a broader range of technological topics and knowledge. In addition, two of the AI degrees—in the Technical University of Sofia and New Bulgarian University—are offered in the form of selectable specialization. When all examined BSc degree curriculums are considered, a total of 64 programs—or 41.1%—include a course dedicated to AI. Of the 28 evaluated HEIs, 15 include AI-dedicated courses in 50% or more of their bachelor's degree programs. In 17 BSc programs (11% of the total number of available BSc programs),

there is more than one course dedicated to AI. Out of those, in six cases there are more than two available AI-dedicated courses and there is a very strong focus on AI technologies.

The results from the analysis on the inclusion of AI courses in master's degree programs is presented in Table 4. The table is structured identically to Table 3.

Table 4. Overview of MSc degree programs containing AI courses and AI-dedicated MSc degree programs for examined universities.

University	Total Number of MSc	MSc with AI Dedic. Course	AI Dedic. MSc Degree	MSc with >1 AI Course	AI Course Inclusion in MSc [%]
Technical University of Sofia	32	10	0	2	31.2%
Sofia University "St. Kliment Ohridski"	27	13	1	6	48.1%
Technical University of Varna	23	7	1	1	30.4%
Technical University of Gabrovo	8	1	0	0	12.5%
"Angel Kanchev" University of Ruse	13	3	0	2	23.1%
"Nikola Vaptsarov" Naval Academy	3	0	0	0	0
"Paisii Hilendarski" University of Plovdiv	15	2	1	0	13.3%
New Bulgarian University	6	2	0	1	33.3%
University of Library Studies and Information Technologies	12	4	1	0	33.3%
American University in Bulgaria	0	0	0	0	0%
University of Chemical Technology and Metallurgy	2	0	0	0	0%
"Konstantin Preslavsky" University of Shumen	12	3	0	2	25.0%
Trakia University Stara Zagora	6	4	0	0	66.6%
Higher School of Transport "Todor Kableshkov"	4	0	0	0	0%
University of Food Technologies	3	2	0	0	66.6%
South-West University "Neofit Rilski"	18	2	0	1	11.1%
University of Veliko Turnovo "St. Cyril and St. Methodius"	8	0	0	0	0%
Medical University Varna "Prof. Dr. Paraskev Stoyanov"	2	0	0	0	0%
European Polytechnical University	3	0	0	0	0%
Varna University of Management	0	0	0	0	0%
University of Economics–Varna	2	0	0	0	0%
Varna Free University "Chernorizets Hrabar"	3	0	0	0	0%
Burgas Free University	11	4	1	0	36.4%
University of Telecommunications and Posts	3	1	0	1	33.3%
University of Mining and Geology "St. Ivan Rilski"	4	0	0	0	0
"Prof. Dr. Asen Zlatarov" University-Burgas	7	4	1	0	57.1%
National Military University "Vasil Levski" *	7	1	1	na	14.3%
Georgi Benkovski" Bulgarian Air Force Academy *	5	na	0	na	0
Total:	239	63	7	16	26.4%

* Curriculums for the offered degrees are not publicly available. na—not applicable.

During the evaluation, a total of 235 MSc programs were examined. Currently, seven MSc degree programs dedicated to AI are offered in seven universities: Sofia University "St. Kliment Ohridski", Technical University of Varna, "Paisii Hilendarski" University of Plovdiv, University of Library Studies and Information Technologies, Burgas Free University, "Prof. Dr. Asen Zlatarov" University–Burgas, and National Military University "Vasil Levski". The university with the highest number of master's degree programs which include an AI-dedicated subject is Sofia University "St. Kliment Ohridski" with 13 MSc programs—48.1% of all MSc programs in the examined professional fields. Sofia University is also the HEI with most MSc programs (6) which include more than one AI-dedicated course, with this constituting 40% of all master's degree programs with more than one AI subject for all examined universities. The overall inclusion of AI-dedicated subjects in MSc courses is lower than in BSc courses—24.2%. This difference of the inclusion rate of 14.4%

is expected as master's degree programs are focused at a specific area of interest, with the included courses covering specialized topics in the area.

During the evaluation process, 174 courses were covered by the applied selection criteria, with details about their distribution presented in Table 5. The examined universities are listed in the first column, while columns two and three contain the number of compulsory and elective AI courses included in the BSc programs. The fourth column contains the average value for the semester in which the subjects are offered. The average semester parameter is obtained by calculating the mean value of the semesters for all courses for the given degree (BSc or MSc). The last three columns are structured as columns two to four and contain identical information regarding the courses included in the MSc degree programs. The dashes in the columns indicate that no degree programs of that category are offered in the given university.

Table 5. Available AI-dedicated courses in BSC and MSc degree programs in the examined professional fields for all evaluated universities.

University	BSc Comp.	BSc Elect.	Avrg. Sem.	MSc Comp.	MSc Elect.	Avrg. Sem.
Technical University of Sofia	9	6	6.9	7	6	1.9
Sofia University "St. Kliment Ohridski"	4	7	6.2	3	18	1.3
Technical University of Varna	3	2	6.6	0	7	1.4
Technical University of Gabrovo	1	2	7.7	0	1	2
"Angel Kanchev" University of Ruse	5	0	5.8	4	8	1.7
"Nikola Vaptsarov" Naval Academy	3	2	5.4	-	-	-
"Paisii Hilendarski" University of Plovdiv	1	0	6	0	1	3
New Bulgarian University	2	0	8	3	0	2
University of Library Studies and Information Technologies	6	2	6.7	2	2	1.5
American University in Bulgaria	-	-	-	-	-	-
University of Chemical Technology and Metallurgy	1	1	6	-	-	-
"Konstantin Preslavsky" University of Shumen	1	4	6.2	2	3	1.6
Trakia University Stara Zagora	0	2	5.5	0	4	2
Higher School of Transport "Todor Kableshkov"	-	-	-	-	-	-
University of Food Technologies	-	-	-	2	0	2
South-West University "Neofit Rilski"	1	1	5	3	0	1.7
University of Veliko Turnovo "St. Cyril and St. Methodius"	3	2	4.8	-	-	-
Medical University Varna "Prof. Dr. Paraskev Stoyanov"	1	0	7	-	-	-
European Polytechnical University	1	0	3	-	-	-
Varna University of Management	0	1	5	-	-	-
University of Economics–Varna	5	0	6.2	1	0	2
Varna Free University "Chernorizets Hrabar"	-	-	-	-	-	-
Burgas Free University	1	0	4	3	0	2
University of Telecommunications and Posts	5	1	5.7	1	0	2
University of Mining and Geology "St. Ivan Rilski"	-	-	-	-	-	-
"Prof. Dr. Asen Zlatarov" University-Burgas	2	0	7	0	3	3
National Military University "Vasil Levski" *	na	na	na	na	na	na
Georgi Benkovski" Bulgarian Air Force Academy *	na	na	na	na	na	na
Total:	55	33	(5.9)	31	53	(1.9)

* Curriculums for the offered degrees are not publicly available. na—not applicable.

As it can be seen in from Table 5, the number of courses available is almost evenly split between BSc and MSc degrees, at 88 to 86. It should be noted that in several cases, in the examined curriculums include the option for a choice between two AI courses. As only one of the two could be selected by students and the other would no longer be available to them, such cases are examined as a single compulsory course. In the case of bachelor's degree programs, the majority of AI courses (62.5%) are compulsory. The largest number of AI courses is included in courses in professional field 4.6: Informatics and Computer Science—38 of the outlined 88 courses. Additionally, courses in this field are comprehensive in their majority of 76.3%. The field with second-largest number of AI

courses is 5.3: Communication and Computer Technologies, containing 32 of the 88 outlined courses. In this case, however, the ratio between compulsory and elective courses is nearly equal at 17 to 15. The semester in which the courses are taught varies between degree programs and universities but, as it can be seen from the average semester ratings, it is predominantly in the last third of the student's education, in the 6th, 7th, and 8th semester, or 5.9 on average for all universities. For the examined MSc degree programs, in contrast to the BScs, the courses are mostly elective, with only 36% of courses being compulsory. As in the case with BSc degrees, most courses, 50%, are in courses in professional field 4.6: Informatics and Computer Science, followed by courses in 5.3: Communication and Computer Technologies, containing 34.5% of all examined courses. One of the differences observed in MSc degree programs when compared to BScs is that courses in professional field 5.2: Electrical Engineering, Electronics, and Automation are third by distribution, with 12.8% of all AI subjects, while courses in this professional field include the lowest number of AI-dedicated subjects on the BSc level, with 8%, constituting a total of seven subjects in all examined courses. The distribution of the examined courses between different professional fields is presented in Figure 3.

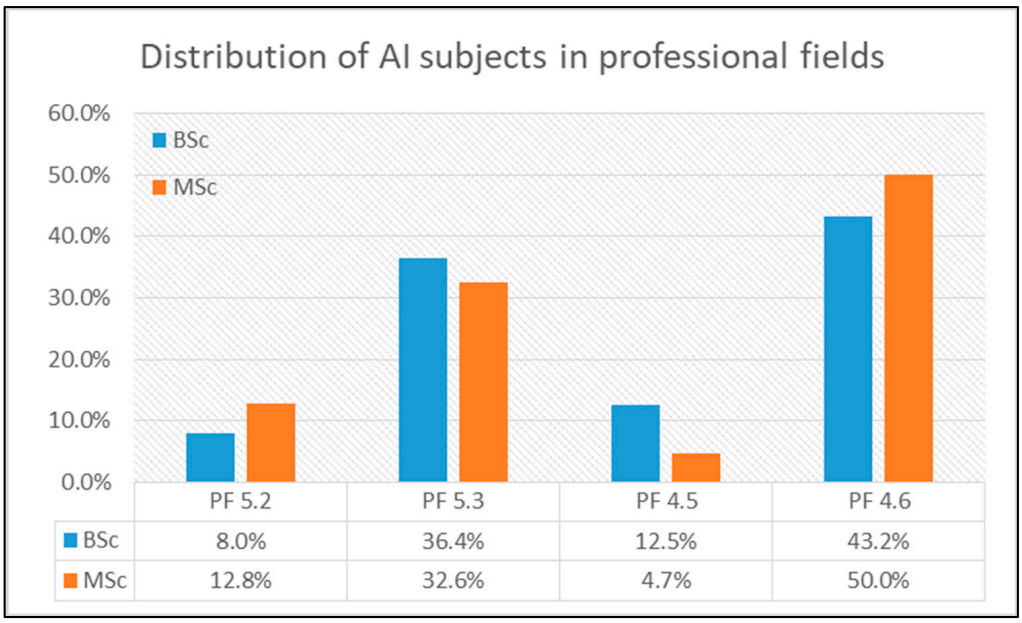

Figure 3. Distribution of AI-dedicated courses in BSc and MSc degree programs for each of the four examined professional fields.

In order to make an assessment on the current impact of the inclusion of AI courses in degree programs, information regarding student enrollment in the evaluated universities has been gathered. The obtained data are presented in Table 6, where the number of students in each professional field for the different HEIs is presented in columns two to five. The last column contains information regarding the total enrollment of students pursuing a degree in the examined professional fields. In addition, Figure 4 presents the relation between the number of students in the universities and the percentage of BSc and MSc degree programs including AI-dedicated education.

As it can be seen from Table 6 and Figure 4, the total number of students being affected from the examined degree programs varies greatly between universities, from 18 to 4244. In some cases where a given university offers one or two degree programs in a the examined professional fields which include a AI course, a 100% coverage of the students is achieved. For universities with a higher number of students, the coverage of the AI training cannot be directly calculated based on the percentage of degree programs including AI education, as the distribution of students between degree programs is not equal. However, for universities with a high number of students in the

examined professional fields (>1000), the level of inclusion of AI in BSc degree programs is consistently high (35% or more). Another factor that should be accounted for is that professional fields 5.3 and 4.6 have both the highest percentage of AI inclusion in degree programs (both BScs and MScs) as well as the highest student enrollment, at a total of 14,440 students for the academic 2023/2024 year.

The relations between student enrolment and AI inclusion in degree programs are further analyzed using correlation analysis. In particular, the correlation coefficients between student enrollment and AI inclusion in degree programs are presented in Figure 5. In particular, the figure presents the correlation coefficients between the number of students pursuing a degree in the four examined fields and the percentage of BSc degree programs including dedicated AI courses (denoted as BSc_Sub), number of AI-dedicated BSc degree programs (denoted as BSc_Ded), number of BSc degree programs with multiple (>1) AI courses (BSc_High), percentage of MSc degree programs including dedicated AI courses (denoted as MSc_Sub), number of AI-dedicated MSc degree programs (denoted as MSc_Ded), and number of MSc degree programs with multiple (>1) AI courses (MSc_High).

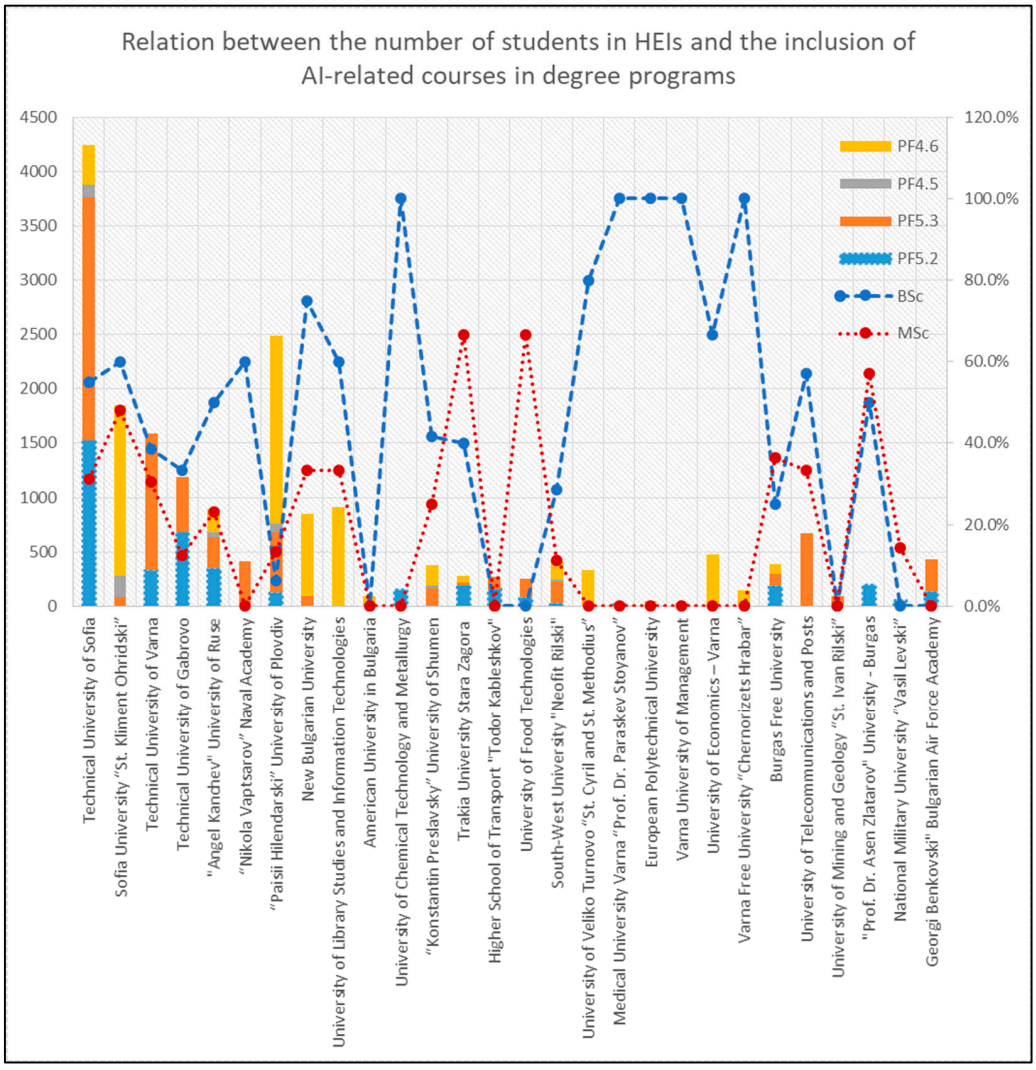

Figure 4. Relation between student enrolment in HEIs and the inclusion of AI courses in BSc and MSc degree programs.

Table 6. Number of students attending degree programs in each of the four examined professional fields for the evaluated universities for the academic 2023/2024 year.

University	PF5.2	PF5.3	PF4.5	PF4.6	Inst.
Technical University of Sofia (TUS)	1529	2234	117	364	4244
Sofia University "St. Kliment Ohridski" (SU)	-	80	199	1566	1845
Technical University of Varna (TUV)	330	1262	-	-	1592
Technical University of Gabrovo (TUG)	682	502	-	-	1184
"Angel Kanchev" University of Ruse (UR)	348	288	44	210	890
"Nikola Vaptsarov" Naval Academy (NA)	-	408	-	-	408
"Paisii Hilendarski" University of Plovdiv (UP)	126	556	75	1734	2491
New Bulgarian University (NBU)	-	89	-	760	849
University of Library Studies and Information Technologies (ULSIT)	-	-	-	912	912
American University in Bulgaria (AUB)	-	-	6	87	93
University of Chemical Technology and Metallurgy (UCTM)	146	-	-	-	146
"Konstantin Preslavsky" University of Shumen (US)	-	160	25	195	380
Trakia University Stara Zagora (TU)	190	22	-	69	281
Higher School of Transport "Todor Kableshkov" (HST)	156	112	-	-	268
University of Food Technologies (UFT)	79	176	-	-	255
South-West University "Neofit Rilski" (SWU)	26	199	18	165	408
University of Veliko Turnovo "St. Cyril and St. Methodius" (UVT)	-	-	0	331	331
Medical University Varna "Prof. Dr. Paraskev Stoyanov" (MUV)	18	-	-	-	18
European Polytechnical University (EPU)	-	-	-	51	51
Varna University of Management (VUM)	-	-	-	33	33
University of Economics–Varna (UEV)	-	-	-	476	476
Varna Free University "Chernorizets Hrabar" (VFU)	-	-	-	143	143
Burgas Free University (BFU)	188	109	-	85	382
University of Telecommunications and Posts (UTP)	-	673	-	-	673
National Military University "Vasil Levski" (NMU)	-	92	-	-	92
University of Mining and Geology "St. Ivan Rilski" (UMG)	194	-	-	-	194
Georgi Benkovski" Bulgarian Air Force Academy (BAFA)	47	-	-	-	47
"Prof. Dr. Asen Zlatarov" University–Burgas (UB)	135	297	-	-	432
Total:	4194	7259	484	7181	19,118

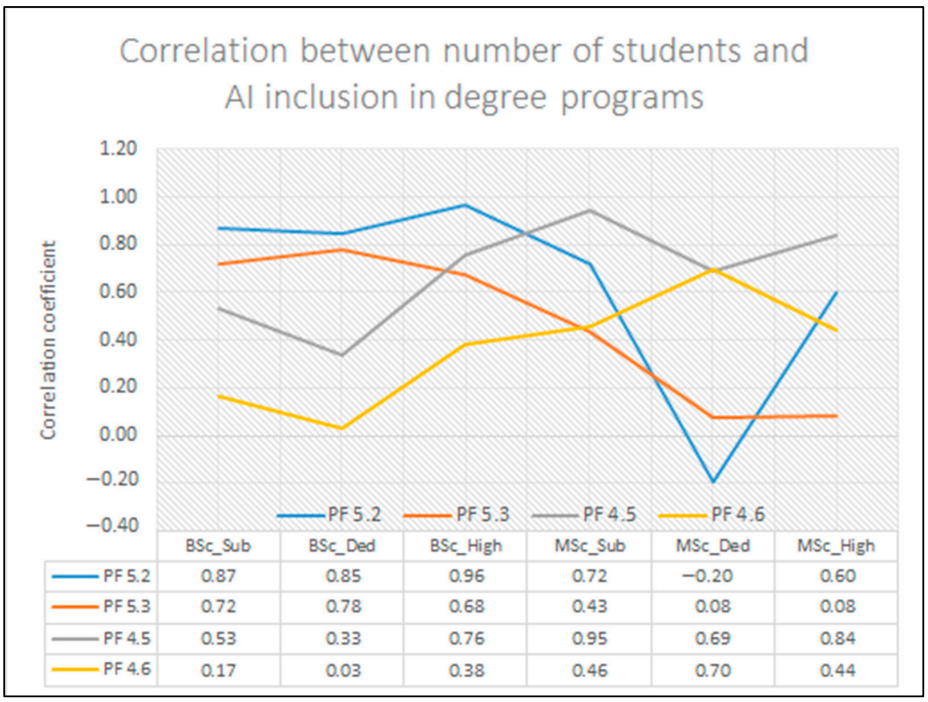

Figure 5. Correlations between students in HEIs, according to professional field, and the inclusion of AI courses in BSc and MSc degree programs.

The results of the conducted correlation analysis show that for degree programs in the technical fields of education (5.2 and 5.3), the number of BSc AI courses and degree programs strongly correlates with increases in the number of students. This can be attributed to the fact that in larger institutions a wider number of specialized degree programs are offered, which indicates that AI courses in these fields are often viewed as supplementary to the degree program, rather than essential. The reverse effect is observed in BSc degree programs in professional field 4.6: Informatics and Computer Science, where the number of students has a very low correlation with the inclusion of AI courses. A reversal of these effects is seen in the case of MSc degree programs. In that case, the offering of specialized degree programs is broadened to a larger number of HEIs.

6. Discussion

The current study presents an evaluation of the level of integration of AI-dedicated degree programs and courses in Bulgarian higher education institutions for bachelor's and master's degree curriculums, related to the field of Information Technologies and Computer Science. In detail, a total of four professional fields are examined (as per the definitions of the Bulgarian Ministry of Education and Science): (1) 5.2: Electrical Engineering, Electronics, and Automation; (2) 5.3: Communication and Computer Technologies; (3) 4.5: Mathematics; and (4) 4.6: Informatics and Computer Science. The analysis is conducted using publicly available data from all universities which are included in the ranking in of the Bulgarian university ranking system for the examined professional fields.

6.1. What Is the Level of Inclusion of AI-Related Teaching in Bulgarian Universities in the Field of Computer Science and Information Technology?

At the current moment, there are a total of 12 available degree programs in AI–five BSc courses and seven MSc courses. Additionally, the opportunities for degrees in AI courses are not focused in a single metropolitan location, but are instead available in various major cities in the country, which facilitates wider access to AI degree programs. When the wider integration of AI-dedicated subjects in BSc and MSc courses is considered, there is a varying level of inclusion for the different professional fields. The highest level of integration of AI-specific courses in the curriculums is observed for degree programs in the field of Informatics and Computer Science, both for BSc and MSc courses. Of the 174 courses covered by the current study in both levels of education, 46.5% were in degree programs listed under professional field 4.6. The field containing the second-largest amount of the overall courses which include AI-dedicated subjects is 5.3: Communication and Computer Technologies, at 34.5%. In the context of the European framework, Dec et al. [70] report that 64 degree programs (both BSc and MSc) in four European universities are examined and 50 courses related to AI are identified, which can be presented as ratio of 0.78 courses per degree. For the currently conducted study, the ratio for all examined professional fields 0.43. The observed difference is caused by the low degree of inclusion of AI-related courses in degree programs related to the field of Electrical Engineering, Electronics, and Automation, with comparable results being observed when only professional fields 4.6 and 5.3 are considered. The results regarding the average semester of delivery are also comparable, with the courses being delivered traditionally in the last third of the BSc degree.

6.2. To What Degree Does AI-Related Education Affect Students Currently Pursuing a BSc and MSc Degree in the Field of Computer Science and Information Technology

The obtained results show varying levels of effect based on the field of the selected degree program. Students attending degree programs strongly related to Computer Science (namely in the fields of Communication and Computer Technologies and 4.6: Informatics and Computer Science) receive a strong foundation in regard to the creation and functionality of AI systems. The inclusion of such topics in more degrees in distant professional fields is strongly dependent on the size of the HEI and the number of students and available degree programs. The availability and coverage of AI courses is additionally supported by

the fact that both BSc and MSc degree programs are available in a number of different institutions. As previously highlighted, Electrical Engineering, Electronics, and Automation is the professional field with the lowest level of inclusion of AI courses in degree programs, as only 8.0% of identified courses were in degree programs in this field. Given that students pursuing a degree in the field are going to be directly affected by the introduction of AI systems in their respective fields and may be required not only to actively use but also implement them, a knowledge gap between in the acquired skillset of the graduates and the requirements of the labor market may emerge. This, in turn, may either cause graduated students to seek further training, slowing down or impairing their transfer from education to business, or may cause employers to organize and provide additional courses and trainings for employed personnel. Although further examination is required, it can be assumed that the observed trend of a decrease in AI-dedicated courses for degree programs further away from the field of IT and Computer Sciences is only amplified. The importance of the issue can be further highlighted by noting that those technical degree programs include 77% of the total number of students pursuing a technical degree in Bulgarian HEIs during the 23/24 academic year [83].

7. Conclusions

Bulgarian education in Artificial Intelligence is increasingly represented in BSc and MSc degrees in Information Technologies and Computer Sciences through dedicated courses, specialized degree programs, and elective courses. However, the distribution of these opportunities is uneven across various examined programs and academic fields. Disparities in AI education can disadvantage students in degrees lacking dedicated AI courses, especially those outside IT and Computer Sciences. The trend of reduced AI content in non-IT degrees may be even more pronounced in other scientific and professional fields.

7.1. Implication for Practice

The conducted evaluation revealed that AI-related BSc and MSc degrees and courses are widely available in educational programs directly linked to Information Technologies and Computer Sciences, such as Communication and Computer Technologies and Informatics and Computer Science. This suggests that students enrolled in these programs are gaining valuable knowledge and skills in the creation, maintenance, and application of AI systems, preparing them to meet the evolving demands of the job market.

However, students in fields adjacent to Information Technologies and Computer Sciences, where AI education is less emphasized, may face challenges as the required skillsets in the workforce continue to shift. This issue is significant for students in Electrical Engineering, Electronics, and Automation, which are industries experiencing rapid technological change. For example, the field of electronics and electronic engineering is one where contemporary Computer-Aided Design (CAD) software often includes AI-based features. Without adequate training, users may struggle to fully understand these systems or leverage their capabilities effectively. Consequently, new professionals may need longer onboarding periods or additional training when transitioning from education to industry.

7.2. Implication for Policy

The rapid adoption of AI necessitates measures to minimize its impact on the workforce. The conducted study shows most universities—especially those which provide education in the fields of Communication, Informatics and Computer Science—have included courses related to AI in the offered degree programs. As such, a capacity for education and training in the field of AI has been created and future development policies can be focused on its continued development and broadening of its reach. Policies which support those goals can have two main targets: university students and working professionals. For the first target group, enhancing elective courses through better promotion, incentives, and integration into degree programs can increase student engagement. Currently, elective courses often do not play a vital role in degree programs and are often overlooked by stu-

dents. When targeting working professionals, offering AI-related training through lifelong learning initiatives can help businesses integrate AI without major workforce disruptions.

7.3. Limitations

The conducted study evaluates the inclusion of AI-focused education in BSc and MSc degree programs in Information Technologies and Computer Sciences offered by Higher Education Institutions (HEIs) in Bulgaria. Firstly, as previously highlighted, due to the applied selection criteria, this study tends cover more subjects that are strongly dedicated to AI topics and, as a result, presents a more conservative estimation on the level of integration of AI subjects and their availability. Additionally, as this study is focused specifically on the field of Computer Sciences and IT, it does not cover other technical and scientific fields such as Mechanical Engineering, Physics, and Chemistry, as AI's major impact and development are currently concentrated on IT-related sectors. This study also does not consider historical data, and thus does not provide insights into the evolution of AI education over time. Furthermore, the presented evaluation focuses on the availability of AI education without assessing the quality of the degree programs and courses offered.

7.4. Further Research

This study provides an initial overview of the capacity of Bulgarian HEIs to address the evolving demands of the labor market regarding AI education. Future research will aim to expand the scope to include other technical and scientific fields and conduct a detailed evaluation of course content, program structures, and quality of learning outcomes. Additionally, future research will assess whether educational offerings align with business needs, monitor AI-related employment trends, and evaluate the responsiveness of the education system to shifts in the AI-driven job market, including opportunities in both large companies and startups.

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