



NVAO • THE NETHERLANDS

INITIAL ACCREDITATION

HBO-BACHELOR

B APPLIED DATA SCIENCE AND ARTIFICIAL
INTELLIGENCE

Zuyd University of Applied Sciences

FULL REPORT

14 DECEMBER 2023

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1 Peer review

The Accreditation Organisation of the Netherlands and Flanders (NVAO) determines the quality of a new programme on the basis of a peer review. This initial accreditation procedure is required when an institution wishes to award a recognised degree after the successful completion of a study programme.

The procedure for new programmes differs slightly from the approach to existing programmes that have already been accredited. Initial accreditation is in fact an ex ante assessment of a programme. Once accredited the new programme becomes subject to the regular review process.

The quality of a new programme is assessed by means of peer review. A panel of independent peers including a student reviews the plans during a site visit to the institution. A discussion amongst peer experts forms the basis for the panel's final judgement and the advisory report. The agenda for the panel visit and the documents reviewed are available from the NVAO office upon request.

The outcome of this peer review is based on the standards described and published in the limited NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2019, nr. 3198). Each standard is judged on a three-point scale: meets, does not meet or partially meets the standard. The panel will reach a conclusion about the quality of the programme, also on a three-point scale: positive, conditionally positive or negative.

NVAO takes an accreditation decision on the basis of the full report. Following a positive NVAO decision with or without conditions the institution can proceed to offer the new programme.

This report contains the findings, analysis and judgements of the panel resulting from the peer review. It also details the commendations as well as recommendations for follow-up actions. A summary report with the main outcomes of the peer review is also available.

Both the full and summary reports of each peer review are published on NVAO's website www.nvao.net. There you can also find more information on NVAO and peer reviews of new programmes.

2 New programme

2.1 General data

| | |
|-----------------------|---|
| Institution | Zuyd University of Applied Sciences (Hogeschool Zuyd) |
| Programme | HBO-Bachelor B Applied Data Science and Artificial Intelligence |
| Variants | Fulltime: Ja. Parttime: Nee. Dual: Nee. |
| Degree | Bachelor of Science |
| Locations | Maastricht |
| Study load | 240 EC ¹ |
| Field of study | Technology (confirmed by panel) |

2.2 Profile

Zuyd University of Applied Sciences (Zuyd) intends to offer the hbo-bachelor Applied Data Science & Artificial Intelligence (ADS&AI). ADS&AI professionals will be equipped to solve complex social challenges by using Applied Data Science and Artificial Intelligence. The ADS&AI programme focuses on human-centred Artificial Intelligence within a wide range of domains such as chemistry, engineering, business sciences, mathematics, and IT. Throughout the programme, students will acquire the necessary skills to apply data science and AI on real-life situations, employing the *Design Science Method (R&D)*. Students will also gain knowledge and skills related to data engineering, human-computer interaction, mathematics, and programming. On top, students will learn how to use human cognition concerning perception, memory, attention, language processing, and problem solving to be able to develop intuitive, empathetic, and user-friendly AI systems. The bachelor's programme ADS&AI will be part of the new Data Science and AI Academy. Applied research during the programme is facilitated by the research centre Data Intelligence.

2.3 Panel

Peer experts

- Prof. Dr. Rob Koper, (*chair*), University professor at the Open University, focusing on educational innovation educational sciences, ICT in education and data science;
- Fiona Schrage MSc, Programme manager Bachelor Creative Media & Game Technology. Former Project leader (TNO) Associate degree Mechatronics in the Smart Industry and former teacher of Professional Skills Engineering (Ad and B);
- Drs. Frans van den Akker, Business developer at Industry BL Digital RHDHV. Programme manager Digitalisation TKI E&I, TKI Nieuw Gas and Liason officer NL AI Coalition. Member research & innovation working group NL AI coalition;
- Justin Saaman (*student*), studies HBO-ICT at HZ University of Applied Sciences.

Assisting staff

Yvet Blom (secretary)

Frank Wamelink (NVAO policy advisor and process coordinator)

Site visit

9 november 2023, Zuyd University of Applied Sciences in Maastricht

¹ European Credit Transfer System

3 Outcome

The NVAO approved panel reaches a positive conclusion regarding the hbo-bachelor Applied Data Science & Artificial Intelligence offered by Zuyd University of Applied Sciences (Zuyd). The programme complies with all standards of the limited NVAO framework.

The ADS&AI programme has a workload of 240 ECTS and trains students to become professionals who are capable of solving complex, data-related societal challenges. Zuyd works closely together with the industry, universities (of applied sciences), and knowledge centres. These field representatives are excited about the programme. They have contributed to its development and will play an active role in its implementation.

Throughout the four-year programme, the focus lies on data science and Artificial Intelligence. Students develop skills in data engineering, human-computer interaction, mathematics, and programming, applying their acquired data science and AI skills in real-life situations. Practical assignments are carried out within learning communities, where students collaborate with and learn from each other. An active feedback culture is being developed, in which students receive regular feedback from teachers, fellow students, and company supervisor to improve their performance. Teachers are closely involved and possess relevant knowledge and experience to guide students adequately. Students work on practical assignments following the Design Science Method (R&D). Zuyd teaches this method due to its focus on developing innovative products and services.

Assessment consists of formative, and especially a significant amount of summative assessment. The panel recommends reducing the number of summative assessments and creating a better balance between summative and formative assessment. The examination committee possess a lot of knowledge about the structure of ADS&AI and the assessment methods, ensuring effective quality assurance of assessments.

In conclusion, Zuyd introduces a well-designed, practical study programme with the hbo bachelor's programme ADS&AI. Students have the opportunity to use data science and AI to solve problems of organisations and the larger society. The panel concludes that this new programme meets the required quality standards.

| Standard | Judgement |
|----------------------------------|--------------------|
| 1. Intended learning outcomes | meets the standard |
| 2. Teaching-learning environment | meets the standard |
| 3. Student assessment | meets the standard |
| Conclusion | <i>positive</i> |

4 Commendations

The programme is commended for the following features of good practice.

1. Relevant programme – The Dutch region of (South) Limburg has a shortage of skilled technical personnel. Zuyd aims to attract Dutch and international students, with the hope that future professionals will settle permanently in (South) Limburg region after graduation.
2. Strong network – Zuyd has a strong network consisting of regional businesses, companies, educational partners and knowledge centres. This network contributes by providing Zuyd with input on the curriculum, and is dedicated to offering assignments, internships, and graduation projects for students.
3. Curriculum – Zuyd has aligned its curriculum with the ADS&AI national programme. The ADS&AI curriculum is well-structured in terms of complexity of the programme and the level of autonomy expected from students.
4. Learning communities – Students form learning communities where they work together on assignments. These learning communities have been designed to facilitate a strong learning environment, where students learn with and from each other.
5. Teaching team – Zuyd put together an excited and knowledgeable teaching team for the ADS&AI bachelor's programme. Teachers have expertise in both the ADS&AI field and didactics. They, along with the study career counsellor, will guide students intensively throughout the four years of the ADS&AI programme.
6. Assessment assurance system – Zuyd ensures the quality of assessments through a closely involved examination committee, the principle of multiple examiners (eight eyes) during final assessments, and regular calibration.

5 Recommendations

For further improvement to the programme, the panel recommends a number of follow-up actions.

1. Intended learning outcomes – Clarify and communicate that the ADS&AI performance-indicators can be seen as intended learning outcomes.
2. Professional field consultations – Consistently and systematically organise gatherings with representatives of the professional field to keep the curriculum up-to-date. Especially with small to large businesses, including experts from major IT suppliers and companies using data science.
3. Mathematics and IT – Consider connecting math and IT related topics more to data science and AI. This will probably increase students' enthusiasm about the programme and successfully completing the programme.
4. Onboarding international students – Contribute to ensuring international students feel truly at home and help them become familiar with the language and culture of the South Limburg region.
5. Information – Clearly outline the expectations for both students as well as teachers throughout the programme. Emphasise the programme's strengths, including the close collaboration with regional companies, and the programme's focus on developing soft skills and ethics. These unique selling points should be better highlighted by Zuyd.
6. Assessments - Create a balance between formative and summative assessments. Zuyd currently administers a significant number of summative assessments. Introducing too many 'hurdles' in the programme puts significant pressure on students and increases workload of teachers.

6 Assessment

6.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

Judgement

Meets the standard.

Findings, analysis and considerations

It is clear from the provided information, plus the conversations the panel had during the site visit, that Zuyd produces all-round ADS&AI-professionals. After completing the bachelor, ADS&AI professionals possess a wide range of knowledge and skills. Their skillset allows the future professional to use data, AI, and programming skills to solve complex societal challenges. The professionals understand corporate processes and are aware of the possibilities of data, data science and AI.

Profile

The ADS&AI's profile is based on the national ADS&AI profile², the Body of Knowledge and Skills for Data Science and Artificial Intelligence³ (DS/AI BoKS) and national and international standards for hbo-programmes (NLQF⁴, EQF⁵, and Dublin descriptors). The development team, consisting of researchers from Zuyd's Data Intelligence research centre, stated that they developed an ADS&AI profile that fits the needs of the region. The development team gathered insights from educational institutions and knowledge hubs within the AI Academy⁶, as well as from businesses and organisations. After collecting the information, the development team formulated performance indicators based on the gathered information, consisting of three elements: knowledge, skills, and professional attitude. The indicators form the foundation of the curriculum.

The bachelor is divided into three phases, or as Zuyd calls them "levels", following the national ADS&AI profile. The three levels are: the begin phase, the associate phase, and the professional phase. These levels are derived from the NLQF and indicate the level of complexity and autonomy of each phase.

Before and during the site visit, there was some confusion regarding the intended learning outcomes: the eleven qualifications of the national ADS&AI profile, versus the ten performance-indicators that Zuyd drafted. Zuyd intends to assess students based on both sets of intended learning outcomes, while the national outcomes and Zuyd's learning outcomes can reach their own end level. Zuyd requires students to achieve each of the eleven national end qualifications at level 3 (the professionalisation phase, NLQF level 6). Additionally, students are expected to achieve a minimum of eight out of the ten performance indicators at level 3, and 2 of the 10 at level 2 or 4 (associative phase, NLQF level 5). During the panel discussion with the programme management, Zuyd stated that their performance-indicators can be seen as intended learning outcomes, with the national ADS&AI profile to provide a context in which students perform their professional tasks. The panel believes it is essential that students know exactly what is expected of them and therefore suggests clarifying exactly what students' performance will be based on.

Programme initiation

Programme management stated that the programme has been initiated due to a decline of demographic developments (Limburg is a shrinking province / depopulation area) leading to, amongst others, the pressing shortage of highly skilled technical personnel in Limburg. With this new programme, the aim is to attract both national and international students. By attracting international students, both Zuyd and the

² The national ADS&AI profile is based on the international framework Edison.

³ The DS/AI BoKS is based on the ACM (Association for Computing Machinery) and AIMA (Artificial Intelligence: A Modern Approach).

⁴ The Dutch Qualification Framework (NLQF).

⁵ The European Qualification Framework

⁶ The AI Academy provides AI courses for the regional professional field and consists of educational institutions and knowledge hubs such as Zuyd, Maastricht University, Fontys, and the Brightlands campuses in Heerlen and Venlo.

professional field hope to invest in future professionals who, after graduation, will settle permanently in South Limburg.

Professional field

The professional field representatives with whom the panel spoke during the site visit are enthusiastic about Zuyd's initiation of the ADS&AI programme in the region. They hope that the programme will contribute to delivering future professionals in South Limburg.

The representatives told the panel that, from their experience, businesses increasingly turn to data science and AI to improve their activities, products, and services. The representatives mentioned that the businesses in the region need all-round ADS&AI professionals. Professionals who have the knowledge and skills to accelerate digital transformations. Future ADS&AI professionals will learn to do so by analysing, predicting, and visualising data, in order for businesses to make data-driven decisions. Key skills, according to the representatives, include data translating skills, X-AI, ethical awareness, programming skills and soft skills. Other skills that the future professionals need include embedded software, software development, Python, and data engineering. The representatives believe it is also essential for students to gain knowledge related to new technologies such as the Internet of Senses⁷, computing power, 6G, and augmented reality.

During the conversation with the professional field representatives, the panel noticed that several representatives had not been part of the development of the programme and were not familiar enough with the ADS&AI profile and curriculum. Therefore, the panel requested an additional meeting with the programme management to get a better understanding of the development process and the relevance of the programme for the region.

The programme management indicated that there has been, and continues, significant contribution from the businesses in the region. Zuyd collaborates with a wide range of businesses, companies, universities (of applied sciences), and knowledge hubs. These collaborations are organised into three so called levels: 1. local businesses, 2. branch organisations⁸ and educational partners⁹, and 3. regional context¹⁰. The input of a wide range of representatives contribute to ensuring that Zuyd consults a very broad and well-aligned professional field perspective on what the ADS&AI profile and curriculum should include. The programme consciously is organising all sorts of interactions with the professional field through for example mini-conferences, minor projects, internships, external reviewers of theses, part-time teachers still active in the field, and applied research.

Furthermore, the representatives of all three levels have expressed their commitment to provide assignments, internships, and graduation projects for students. Zuyd chose to invite the complete spectrum of representatives for the panel discussion with the professional field, since this group could share a broader vision of what the professional field needs.

The programme management stated that Zuyd has consciously chosen to align with the professional field via the three levels of collaboration and not for example to align via an advisory board. According to the programme management, an advisory board could exert a guiding influence, potentially introducing bias into the bachelor's programme. By aligning the programme on three levels, Zuyd believes it delivers a curriculum that better meets the requirements of the professional field.

⁷ The "Internet of Senses" is an emerging concept that extends beyond the traditional Internet of Things (IoT). It aims to incorporate human senses into digital experiences, enabling interactions that involve not just sight and sound, but also touch, taste, and smell. This concept is part of a broader vision for the future of the internet, expected to become prominent in the future.

⁸ Branch organisations include Regitel, Learning Community Partners (LCP), Business Contact Day (BCD).

⁹ Educational partners include Vista, the Open University, and Maastricht University.

¹⁰ The regional context includes Zuyd transition themes, Brightlands Smart Services Campus, Brightlands Chemelot Campus, the Data Intelligence research group, and the educational chain.

The panel agrees with the professional field representatives that the ADS&AI bachelor's programme could be a solution for the urgent need for highly skilled professionals in the region. The panel is enthusiastic about Zuyd's strong network and is confident that the strong ties will give students the opportunity to work with regional businesses, companies, educational partners and knowledge centres.

The panel, however, is under the impression that there might be an excessive focus on umbrella organisations like the Brightland campuses and Regitel. Therefore lacking direct access to developments in the professional field. In alignment with the program's strategy, the representatives of these umbrella organisations interviewed by the panel were not informed in detail about the profile and the curriculum and the choices made. Consequently, the panel recommends that, in the ongoing programme development, Zuyd consistently and systematically organises consultations with representatives of the professional field. Especially with small to large businesses, including experts from major IT suppliers and companies using data science.

In summary, the panel states that Zuyd's ADS&AI bachelor programme produces professionals who know how to use data, artificial intelligence, and programming skills to solve complex societal challenges. The programme consists of relevant intended learning outcomes which are based on performance indicators and comply with the bachelor level. The professional field representatives with whom the panel spoke expressed their excitement for the ADS&AI programme and were adamant about the urgent need for more ADS&AI professionals in the region. The panel agrees with the professional field representatives and sees the need for a ADS&AI bachelor in Limburg. The panel is enthusiastic about the strong network of professional field representatives, educational partners, and regional knowledge centres. The panel urges Zuyd to remain in close contact with their network to keep up with the latest developments in the data science and AI industry. Based on the above considerations, the panel determines that the criteria for this standard have been met.

6.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

Judgement

Meets the standard.

Findings, analysis and considerations

The panel notes that the ADS&AI-programme has a well-drafted curriculum. The ADS&AI programme consists of four blocks (quarters) per year, each worth 15 ECTS. The curriculum is structured based on main objectives per course unit and performance indicators. The main objectives describe the intended competency level of the respective course units. Each course unit has clearly outlined performance indicator(s) that students must meet in order to successfully complete a unit. During the programme, students work on assignments regarding to practical data-related issues, using the Design Science Method (R&D). The assignments take place within learning communities. Within these communities students work together to learn from and with each other.

Curriculum lines

The four-year ADS&AI programme (240 ECTS) is divided into three "curriculum lines": the general qualification curriculum line, the DS/AI BoKS curriculum line, and the DS/AI profiling curriculum line. The general qualification curriculum line is based on the NLQF and covers the necessary knowledge and skills each bachelor student is expected to possess. The skills within this curriculum line are not specifically offered via separate courses but rather acquired during other courses (integrally). The DS/AI BoKS curriculum line is based on the ACM and AIMA and covers basic knowledge each DS/AI student should have. The DS/AI profiling curriculum line is based on the national ADS&AI curriculum profile. Throughout this last curriculum line, students can differentiate in the field of DS/AI topics, methods, and/or techniques, such as Deep Learning and NLP.

Course units

Zuyd offers two types of education (course units) within the ADS&AI programme. The first type includes course units linked to qualifications from the national ADS&AI curriculum profile. The second type contains course units based on the BoKS. The focus within the first type of course units lies on acquiring

knowledge and skills necessary to demonstrate being able to work on ADS&AI-tasks in a complex context. This type of course unit consists of data science and AI topics. The second type of course units focus primarily on gaining general DS/AI knowledge and skills. This type of course unit includes 'Foundation and profile-specific BoKS topics.'

Curriculum

The panel finds the ADS&AI curriculum well-structured in terms of complexity of the programme and the level of autonomy expected from students. The curriculum consists of topics that will encourage students to become general ADS&AI professionals. In the foundational phase (level 1, see standard 1), the groundwork for the rest of the bachelor's programme is laid down. Students gain a broad sense of knowledge of the data science and AI field. The first year of the ADS&AI bachelor, the course units Data Science and AI (5 ECTS per block), consists of subjects such as applied data science and AI, human data computer interaction, and software engineering. The course units Foundation and profile-specific BoKS subjects (5 ECTS per subject, 10 ECTS per block), consists of several math subjects and subjects like programming fundamentals, cognitive science, and evolutionary AI.

During the second year of the programme, the associate phase, students gain more in-depth knowledge and skills related to everything they acquired in the previous year. The Data Science and AI course units (10 ECTS per block) than consists of subjects such as probability and statistics, deep learning for communication, and responsible research and innovation. Foundation and profile-specific BoKS subjects (5 ECTS per block) include machine learning, AI-ops, and simulation and operations research. Blocks in the first two years of the bachelor have the same structure. Each block starts with providing students the necessary information for that block (performance indicators and professional products that students need to deliver). Week 1 to 6 of a block consist of separate (theoretical and practical) course units. Students are paired-up and work on small assignments together during those first 6 weeks. In week 7, 8, and 9, students work on a real-life data-related project where students work on both professional tasks and BoKS. Each block is completed, in week 10, by a summative assessment.

According to the panel, the foundational and association phase provide students with a solid understanding of data science and AI. However, in the first year, Zuyd dedicates too much time to basic mathematics and general IT topics. The strong emphasis on mathematics and general IT topics may lead to demotivated students. The panel recommends considering connecting math and IT related topics more to data science and AI in the future. By immediately focusing on data science and AI topics in the first year, the panel expects that students will become (even) more enthusiastic about the programme and have a greater chance of successfully completing the programme.

In the second half of the programme (year 3 and 4), the professionalisation phase, students differentiate by doing an internship, taking elective courses (minors), and carrying out a graduation project. The internship (30 ECTS) takes place in block 1 and 2 of the third year. During the internship, students work within a company or organisation with expertise in the field of AI on one large or multiple small complex assignments. Students will focus on a specific problem or need faced by the respective company or organisation. Assignments are formulated by the student in collaboration with the company. The student and the company supervisor then present the formulated assignment to the educational supervisor, who checks whether the assignment meets the internship criteria. During the internship, students learn to independently perform complex, structured tasks in a familiar context.

In the last two blocks of the third year, and the first two of the fourth year, students follow an elective course: a minor of their choice, worth 15 ECTS. Within the Data Science & AI Academy, students can choose from the following minors: Multi-Agent Systems, Explainable AI, Data Driven Business, and Computer Vision & NLP. During week 1 to 9 of a minor, students will learn to find an innovative solution on a data-related problem or need of a company. The R&D methodology, to conduct the necessary research, is used within each minor. Minors are completed, in week 10, with a summative assessment. Students have the freedom, with the approval of the examination commission, to follow a minor which is offered outside Zuyd.

Graduation project

The graduation project (block 3 and 4 of the last year) takes place at an AI company or an organisation that uses datascience to solve their problems like the chemical industry. The graduation project consists

of a complex practical issue. Similar to the internship, students draft their own assignment, together with a company. Once they are satisfied, students present the assignment to Zuyd's educational supervisor. The educational supervisor checks whether the assignment meets the graduation criteria. Students must demonstrate to the programme examiners that their assignment reflects the intended learning outcomes. The difference between the graduation assignment and the internship lies in the degree of independence and the nature of the task and context. During the graduation assignment, students must prove that they can independently perform complex and unstructured tasks in an unfamiliar context.

Research Skills

Assignments are designed to enable students to practise their research skills. Through engagement with assignments, students learn how to adopt an investigative attitude. Research for the assignments is primarily carried out using the Data Science Method (R&D) methodology, which offers a structured approach to solve business problems with the use of data. Students learn to perform this type of research by applying this method to the cases provided. The development team emphasises the flexibility to incorporate alternative methodologies aligned with the specific needs of the organisation providing the assignment. The Data Intelligence research group plays an important role to guide students in acquiring and refining their research skills.

Learning environment

The didactical approach is based on the learning-by-doing principle, where students acquire knowledge and skills largely by working on data-related practical assignments. Additionally, students attend lectures and tutorials to be handed the tools they need for a specific assignment. Students work together on assignments within learning communities. These learning communities have been designed to facilitate a strong learning environment, where students learn with and from each other.

The programme includes a variety of teaching methods: lectures, instructional sessions, discussions, tutorials, workshops, practical sessions, and progress meetings. To ensure that students master the content of the curriculum, Zuyd uses 'drill-and-practice' exercises: the repeated practice of specific tasks covered both in class and via self-study. Students engage in both on-campus and online education. On-campus education occurs at Zuyd's campus, while online education is accessible through the Moodle digital learning platform.

During the break the panel visited the newly rented floor on which this programme will find its home. The virtual presentation of the plans for the design of the education- and workspaces was impressive and intends to simulate the culture of the professional field. The location is deliberately chosen across the road of the buildings of the Faculty of Science and Engineering of Maastricht University. This proximity contributes to realise the ambition to closely work together.

Internationalisation

The ADS&AI programme is taught in English, as Zuyd aims to attract students from abroad. The professional field convincingly argued that the regional economy can only flourish if additional workforce in this field becomes available. Attracting students from other countries is solving part of the population decline issues in Limburg. Moreover, in anticipation of many (inter)national graduates working with international companies in the future, Zuyd emphasises the importance of English fluency.

Zuyd has several ideas on how to tie foreign students to the region after completing the programme. Zuyd will specifically focus on attracting potential students from Southern and Eastern Europe and the Balkans for recruitment. Zuyd and Maastricht University both have had positive experiences in the past recruiting international students from these areas. Foreign students from countries like Germany and Belgium for example usually return back home after graduating. Both Zuyd and Maastricht University noticed that students from Southern Europe and the Balkans are more likely to settle permanently in Limburg. To facilitate the integration of students into Limburg, Zuyd has developed an onboarding programme. The onboarding programme includes workshops, meetings, activities, facilities, and familiarisation with the (Dutch) language.

The panel understands that international students from Southern Europe and the Balkans may be more inclined to settle down in Limburg than students from Germany or Belgium. Zuyd indicated that the cultural alignment between students from outside the region with the local culture is one of the major

challenges. The panel therefore recommends to make students feel truly at home and help them become familiar with the language and culture continuously throughout the entire study.

Enrollment

The intended commencement date of the ADS&AI is September 2024, with an expected enrollment in the first year of 60 first-year students. Zuyd thinks that the number of students will grow to a maximum of 100 first-year students per year. Students are expected to consist of people with a Dutch havo or vwo diploma with mathematics A or B (or equivalent), an mbo level 4 diploma, or an hbo or wo propaedeutic certificate. In the application Zuyd formulated a requirement regarding mathematics for mbo 4 applicants.

During the site visit, it was still unclear whether this specific math requirement for mbo 4 is allowed legally. The panel noted that, according to Dutch law, anyone with an mbo-4 diploma, regardless of their profile, is admissible to a hbo bachelor programme. The programme management in response, decided to cancel the enforcement of this additional requirement in the case of mbo 4 applicants. They will provide a clear advice on the level of mathematics needed at enrolment and refer to refresher courses offered by the hbo-ICT programme in case of deficiencies.

Teaching team

During the site visit, the panel met with highly motivated and passionate teachers. The teaching team consists of ten teachers who all have relevant didactic knowledge and experience. Each teacher has at least a completed master's degree or are in the process of obtaining one. Five out of the ten teachers have a Ph.D., and one teacher is currently working on a Ph.D.

The programme management and the teaching team have the ambition to keep the curriculum as up-to-date as possible (standard 1), following the rapid changes within the ADS&AI field. Zuyd keeps the curriculum up-to-date with the help of the research centre Data Intelligence and the ADS&AI-teachers. The research centre is led by the Applied AI lector and the Operations Research professor from Maastricht University. Through their research projects, both the lector and the professor are closely connected to data-related societal developments. In the ADS&AI programme, both teachers and students will contribute to the research projects within the research centre.

To keep the curriculum up-to-date, teachers use their contacts within the AI industry to get a better idea on what the ADS&AI-sector needs. One approach involves supervising students during internships and thesis projects, providing teachers with opportunities to engage with industry professionals. Zuyd aims to incorporate industry developments into the ADS&AI programme. The panel appreciates the efforts teachers put into networking. These types of connections are essential to keep a relevant curriculum. While acknowledging Zuyd's substantial efforts in this regard, the panel suggests investing in professionalisation initiatives for teachers to keep up with the speed of developments within the ADS&AI-domain. Additionally, the panel advises the recruitment of a specialised teacher proficient in teaching soft skills. This will enable Zuyd to incorporate strong soft skills in the programme.

Student guidance

The panel is positive about the student guidance Zuyd offers students within the ADS&AI programme. With a teacher-student ratio of approximately 1 to 20, Zuyd has the ability to provide students with the support they require. Support includes classroom guidance, as well as individual and group coaching and feedback. In the first year, the student guidance is very thorough. In the first year, teachers guide students based on what they believe students should know and be able to do. From the second year onwards, students proactively communicate their individual needs.

At the start of the programme, each student gets a study career counselor. The study career counselor guides students throughout the entire four years of the ADS&AI programme. Students can approach the study career counsellor with study and career related questions or issues. The study career counsellor also helps students with choosing an internship, minors, and the graduation project.

During the last 2 years of the programme, students gain practical experience in the ADS&AI domain during their internship and the graduation phase. Individual guidance during their internship and the graduation phase is provided by a so-called company supervisor. A significant part of the ADS&AI programme in the last two years takes place outside of campus. It is therefore crucial that the company

supervisor adequately supports students during their learning process. Potential workplaces must meet these three criteria: it is an AI company or a (large) company with an AI department; the workplace must have sufficient facilities to work on data science and AI matters; and the employees of the company must have sufficient AI knowledge. The panel noted that 'soft skills' remain rather implicit in the performance indicators and student information. Since soft skills are an important part of the curriculum, the panel recommends to include these skills more explicitly in the documentation.

Written Documentation

After speaking to the programme representatives, the panel concluded that the four-year programme is much more comprehensive than the information file suggests. The information file, that was sent to the panel prior to the site visit, implies that the ADS&AI bachelor primarily focuses on mathematics and technology. From the conversations with the programme representatives, it became apparent that the ADS&AI programme includes much more than just mathematics and technology. Important aspects, such as the close collaboration with regional companies, and the fact that the programme addresses the development of soft skills and ethics, has to be better documented. The panel therefore recommends Zuyd to add this information to the documentation in order for (new) teachers and students to get a better understanding of what to expect from the bachelor.

In summary, the panel is of the opinion that the ADS&AI bachelor's programme enables students to become knowledgeable and skilled generalist professionals in the field of Applied Data Science & Artificial Intelligence. The curriculum is well-designed and -structured in terms of complexity of the programme and the level of autonomy expected from students. During the ADS&AI-programme, the focus lies on working on data-related practical issues within learning communities. Students work together on issues for which they develop professional products. The teachers of the programme are competent and passionate. With the help of study career counsellors, they provide students with intensive guidance throughout the entire four years. Based on the above, the panel concludes that the criteria for this standard have been met.

6.3 **Standard 3: Student assessment**

The programme has an adequate system of student assessment in place.

Judgement

Meets the standard.

Findings, analysis and considerations

The ADS&AI has an adequate assessment system in place, which consists of an assessment policy and an assessment programme. The assessment policy of the ADS&AI bachelor is in line with the assessment policy of Zuyd University of Applied Sciences and the ICT Academy. The assessment policy forms part of the 'Education and Examination Regulations' (EER). The ADS&AI has an examination committee, an assessment committee, and an education committee. These committees are responsible for the assessment quality.

During the on-site visit, the panel met (proposed) members of the examination committee and the education committee. The examination committee is responsible for the validity, reliability, and transparency of the assessments. The legal responsibilities of the examination committee include assessment quality, the end level of the ADS&AI bachelor, and the appointment of examiners. The assessment committee operates under the mandate of the examination committee. One of the way the assessment committee safeguards the assessment quality is by assessing whether the assessment models are in line with the aim of the course units. The education committee on the other hand oversees the monitoring and evaluation of assessments and students' experiences regarding assessments. The panel is positive about the involvement of the examination committee. The members have a good understanding of the content of the intended learning outcomes of the ADS&AI and the way they warrant the assessment quality.

Assessment

The assessment policy of the ADS&AI is based on the principle of 'no knowledge, no skill.' The programme representatives believe that a solid foundation ensures that students gain the knowledge

necessary to become skilled ADS&AI professionals. Zuyd intends to regularly evaluate students' knowledge via knowledge exams.

Students have to complete a minimum of two summative assessments during each course unit. Students will also receive feedback to support their learning and development. Feedback is a form of formative assessment which is given throughout course units. The idea is to recognise early when students need to make certain adjustments in order to successfully complete the programme. Students receive feedback from teachers, fellow students, and industry professionals. Zuyd offers a variety of assessment formats, including written assessments with open or multiple-choice questions, project portfolios, presentations, and product assessments.

Each unit in the first two years has a set order. Students work on several small assignments from week 1 to 6 which lead to professional products. These professional products will be included in students' portfolio. The portfolio serves as input for the midterm summative assessment in week 6. In week 7, 8, and 9, students work on practical assignments. For these, students need to show they can apply the acquired knowledge and skills from week 1 to 6. In the last week of a unit (week 10), a final assessment (summative) takes place. This final assessment consists of two parts. The first part is a portfolio assessment (including the professional products developed in week 7, 8, and 9). The second part consists of a knowledge assessment that students must pass.

In addition to the knowledge assessments in week 10, teachers can do minor summative assessments to assess (certain aspects of) performance indicators. When students don't pass an examen, they can redo the exams in week 7 of the next course unit and at the end of the year, in August.

During the on-site visit, the panel addressed the numerous assessment moments that Zuyd has incorporated into the ADS&AI programme. The teaching team indicated that Zuyd consciously chose to regularly conduct summative assessments. The choice is based on research by Cohen-Schotanus¹¹ and on the teaching team's experiences with assessments. Regular assessments show that students experience more moments of success, dedicate more attention to their studies, and ultimately achieve better academic results.

The panel warns for the stress, workload and demotivation that might result from these frequent summative assessments. Introducing too many 'hurdles' in the programme puts significant pressure on students and increases workload of teachers. Therefore, the panel advises to reconsider the number of summative assessments and to create a balance between formative and summative assessments. The panel also refers to general developments in professional higher education toward less but more integral assessment.

Graduation period

During the graduation phase, students conduct a practical research project at an organisation of their choice. Students are responsible for finding a company where they can carry out their graduation assignment. This final project has to accommodate all the competencies of the national profile at level 3. After students have found a suitable company and formulated the Final assignment description, they submit this proposal for approval to the review board from Zuyd. Upon approval, students create a Performance plan, together with the company supervisor and school supervisor. This Performance plan outlines how students intend to meet the performance indicators. In the graduation period, students must demonstrate mastery of the ten performance indicators at the end level.

Students graduate based on the Graduation file consisting of: a portfolio, a reflection on the performance and performance plan and an extended abstract. The portfolio contains the professional products that fits the company's need. The extended abstract contains a concise summary of the research they conducted.

Students must demonstrate the performance indicators at level 3 (NLQF-6). However some variation is made possible. Students are allowed to demonstrate some performance indicators at level 2 (NLQF-5) or 4 (NLQF-7). If students deviate from the standard level (3), they must substantiate and obtain approval

¹¹ e.g. Cohen-Schotanus, J. (2012). De invloed van het toetsprogramma op studiedoelstroom en studierendement. In Van Berkel, H. Jansen, E. & Bax, A. (red.) *Studiesucces bevorderen: het kan en is niet moeilijk*, Bewezen rendementsverbeteringen in het hoger onderwijs, 65-78. Den Haag: Boom Lemma uitgevers.

from both the school supervisor and the company supervisor. The requirement is that students must demonstrate the performance indicators at level 3 for at least 80%.

Assessment

The assessment of course units takes place using clear assessment models (rubrics). For each assessment model, the aspects on which students are evaluated for each performance indicator are described. A performance indicator can be measured with multiple assessments, and a single assessment may measure multiple performance indicators. Students are always individually assessed on their performance. Even in group work. A student completes a course unit if the average of the performance indicators is at least a 5.5.

The final assessment of the Course units is determined by two appointed examiners (by the Board of Examiners; SKE or BKE-certified). Assessors use assessment forms prepared by the assessment committee. Assessors submit the assessment forms to two examiners who are responsible for determining the grades. In their judgment of the student's performance, the examiners consider the assessors' advice and grade the student's assessment both procedurally and content-related. To further ensure the quality of assessments, Zuyd regularly organises calibration sessions.

During the graduation period many steps need agreement or a judgement by the graduation coordinator, Review Board, school accompanist, lectures, etc. For instance: approval of the company, the Final assignment description, the Performance plan etc. The final Graduation file is assessed by four assessors. The assessors include the educational supervisor from Zuyd, a company supervisor, and two assessors who have not supervised the student (an assessor from the programme and an external assessor from the professional field). The performance plan, in which the student describes how they will meet the performance indicators, is assessed by both supervisors: the Zuyd University of Applied Sciences teacher and the company supervisor. The extended abstract is assessed by both assessors (the programme assessor and the external reviewer). They individually complete their assessment forms, which can be modified during the intercollegiate meeting at the graduation session. The grade (the average of the four grades) is then determined by two examiners. The two examiners assess the advice of the assessors. Thus, four assessors are involved in each final project, forming judgments on the student's work at two points in time. Zuyd regularly organises calibration sessions to ensure the quality of assessments during the graduation period.

In summary, the panel is positive about the assessment system of the ADS&AI programme. The quality of assessment is adequately ensured through a closely involved examination committee, the principle of multiple examiners (eight eyes) during final assessments, and regular calibration sessions. The panel also appreciates the strong involvement of the professional field in guiding and assessing internships and graduation projects.

A point of attention is the numerous summative assessment moments during the programme. The panel advises Zuyd to create a better balance between formative and summative assessment to prevent possible study delays. Based on the above, the panel concludes that the assessment component of the programme meets the requirements.

6.4 Degree and field of study

The panel advises awarding the following degree to the new programme: Bachelor of Science
The panel supports the programme's preference for the following field of study: Technology

Abbreviations

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| ADS&AI | Applied Data Science & Artificial Intelligence |
| AI | Artificial Intelligence |
| BKE | the official teaching qualification examination (Basis Kwalificatie Examinering) |
| BoKS | Body of Knowledge & Skills |
| ECTS | European Credit Transfer System |
| EER | Education and Examination Regulations |
| EQF | European Qualification Framework |
| hbo | higher professional education (hoger beroepsonderwijs) |
| NVAO | Accreditation Organisation of the Netherlands and Flanders (Nederlands-Vlaamse Accreditatieorganisatie) |
| wo | academic education (wetenschappelijk onderwijs) |

