



NVAO • NETHERLANDS

ACADEMIC BACHELOR'S
COGNITIVE SCIENCE AND ARTIFICIAL
INTELLIGENCE

Tilburg University

PANEL REPORT



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LIMITED INITIAL ACCREDITATION
PANEL REPORT



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1 Executive summary

The Accreditation Organisation of the Netherlands and Flanders (NVAO) received a request for an initial accreditation procedure regarding a proposed academic bachelor's programme Cognitive Science and Artificial Intelligence at Tilburg University. NVAO convened an expert panel, which studied the information available and discussed the proposed programme with representatives of the institution and the programme during a site visit.

The following considerations have played an important role in the panel's assessment.

In September 2017 Tilburg University started offering a track Cognitive Science and Artificial Intelligence (CSAI) of the bachelor's programme Communication and Information Sciences (CIS). In the academic year 2018/19 the track is in its second year. With the application for a new programme the University wants to turn this track into a programme of its own. The programme will be offered by the Department of Cognitive Science and Artificial Intelligence in the Tilburg School of Humanities and Digital Sciences.

Standard 1

The learning objectives, and hence the curriculum of the CSAI program, are based on the revised KION framework which was developed and is used by all Dutch universities offering Artificial Intelligence programmes. When developing the programme some other Dutch universities were consulted and the university also looked at the content of some relevant programmes abroad. Hence the national as well as the international perspective were taken into account. Being in a School of Humanities and Digital Sciences gives a specific flavour to the programme compared to most other existing programmes: It's an Artificial Intelligence programme with a Cognitive Science flavour. The programme aims to educate people who not only know how computers work, but also know how people interact with computers and how computers affect human behaviour and vice versa. The programme meets the requirements of Artificial Intelligence programmes in general (by using the KION framework), but by defining its own set of intended learning outcomes the programme has added its own specific Cognitive Science flavour.

The panel concludes the programme meets standard 1.

Standard 2

The curriculum of the programme is partly structured into four learning pathways Programming, Mathematics, Methodology, and Machine Learning. Not all modules are placed in one of these pathways, but during the site visit there appeared to be some more (hidden) pathways and there is a lot of communication and consultation between the lecturers of the different pathways and other modules. This convinced the committee of the coherence in the programme. The application file shows the programme covers all intended learning outcomes and during the site visit the panel was told that the level of each learning outcome is built up throughout the programme. The module descriptions in the application file show that learning outcomes have been translated into learning objectives for each module.

The programme is built on a balanced mix of theory and practice. Two core characteristics of the programme are learning by doing and a strong research focus. In the third year, there is plenty of room for students to choose their own courses and topics of interest and to widen their academic perspective. The panel encourages the programme to pay attention to the examples given and cases used in different courses. In the current manuals examples with a Cognitive Science slant seem to prevail above Artificial Intelligence examples. Giving examples relevant to Cognitive Science as well as Artificial Intelligence in many different courses will enhance the coherence in the programme and will stimulate students to integrate the perspectives of both scientific areas and will make the programme a true Cognitive Science and Artificial Intelligence programme.

The literature will be a mix of classic books in combination with state of the art literature complemented with recent articles.

The present target group is quite diverse with respect to their skills level in programming and mathematics at the start of the programme. This is likely to change when the new admission criteria (including a higher level of mathematics) are implemented. Also tailor made assessments and some extra support are offered to those who need this.

The staff of the CSAI department consists of researchers who are active in the domains of artificial intelligence, cognitive science, and data science. Since the programme is new, the staff is young and enthusiastic and has state-of-the-art expertise in the field of Artificial Intelligence. The expertise of the staff covers all mandatory courses of the programme and are all in the process of getting the University Teaching Qualification (UTQ). Because of the popularity of Artificial Intelligence with both students and teachers the university foresees a possible shortage of lecturers and is already looking for more staff. In view of the expected large interest of students for the CSAI programme, the panel recommends that the programme should take care to strengthen its internal organisation to function on a larger scale. Also in view of the pressure on facilities and other aspects of the learning environment, the panel recommends a controlled increase in the number of students.

The programme meets standard 2

Standard 3

The panel thinks there is a thorough system in place to ensure the quality (validity, reliability and transparency) of the assessments. The quality of assessments is safeguarded by a very capable group of people: lecturers and members of the examination board and the assessment committee are all trained for their job. The Examination Board is now made up of members from the Humanities programmes and one member of the Cognitive Science & Artificial Intelligence Department. Considering the expected growth of the programme the panel stresses the importance of an adequate representation of both Cognitive Science and Artificial Intelligence in the Examination Board.

Some examples of summative assessments show a focus on knowledge reproduction questions whilst part of the learning objectives were formulated at a higher (skills) level. The panel also wonders whether the formative assessment (which are not graded) for programming and other skills will ensure that students have sufficient skills when reaching their final project. The panel therefore recommends the programme to make sure that the questions asked are aligned with the learning objectives, and also to assess (with a grade) the students' level of competencies already before the final project.

The thesis guideline gives a clear description as to how the research should be carried out, what the process looks like and which are the requirements of the report. The rubrics which are used to assess the thesis match the elements mentioned in the guideline and are a useful instrument for the assessors. The panel recommends adding information about the scope of the research to the thesis guideline.

The programme meets standard 3

The panel concludes that the programme meets all assessment standards. Given these considerations, the panel advises NVAO to take a positive decision regarding the quality of the proposed academic Bachelor's programme Cognitive Science and Artificial Intelligence of Tilburg University

The panel advises to award the degree Bachelor of Science (MSc) to the Academic Bachelor's programme Cognitive Science and Artificial Intelligence. The panel supports the programme's preference for the CROHO field of study 'Natuur'.

The Hague, 2 May, 2019

On behalf of the assessment panel convened for the initial limited accreditation assessment of the programme academic bachelor's Cognitive Science and Artificial Intelligence at Tilburg University.

Prof.dr. Dirk Heylen
(Chair)

Drs. T. Kleene
(Secretary)

2 Introduction

2.1 The procedure

NVAO received a request for an initial accreditation procedure including programme documents regarding a proposed academic bachelor's programme Cognitive Science and Artificial Intelligence at Tilburg University. The request was received on 13th November 2018 from Tilburg University. At 22nd March the panel received additional documentation which was made available on a SURF website.

An initial accreditation procedure is required when a recognised institution wants to award a recognised bachelor's or master's degree after the successful completion of a study programme. The procedure for initial accreditation is slightly different as compared to the approach for programmes that have already been accredited. Initial accreditation is in fact an ex ante assessment of a programme. The programme becomes subject to the normal accreditation procedures once initial accreditation has been granted.

To assess the program, the NVAO convened an international panel of experts (see also Annex 1: Composition of the panel). The panel consisted of:

- Prof.dr. Dirk Heylen, Professor of Socially Intelligent Computing, Department Computer Science, University of Twente
- Prof.dr. Bart de Boer, Professor/researcher, Artificial Intelligence-lab, Vrije Universiteit Brussel
- Dr. Evert Haasdijk, Senior Manager, Deloitte
- Menno van Gameren, Student Future Planet Studies, Universiteit van Amsterdam

This composition reflects the expertise deemed necessary by NVAO. (Annex 1: Composition of the panel). All the panel members signed a statement of independence and confidentiality.

On behalf of the NVAO, Thomas de Bruijn and drs. Tineke Kleene were resp. responsible for the process-coordination and the drafting of the experts' report.

The panel has based its assessment on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458).

The following procedure was undertaken. The panel members prepared the assessment by analysing the documents provided by the institution (Annex 3: Documents reviewed).

The panel organised a preparatory meeting on 2nd April 2019 i.e. the day before the site visit. During this meeting, the panel members shared their first impressions and formulated questions for the site visit.

The site visit took place on 3rd April 2019 at Tilburg University. During this visit, the panel was able to discuss the formulated questions and to gather additional information during several sessions (Annex 2: Schedule of the site visit). Afterwards, the panel discussed the findings and considerations and pronounced its preliminary assessments per theme and standard. At the end of the site visit, the initial findings were presented to the institution.

Based on the findings, considerations and conclusions the secretary wrote a draft advisory report that was first presented to the panel members. After the panel members had commented on the draft report, the chair endorsed the report. On 2 May 2019 the advisory report was sent to the institution, which was given the opportunity to respond to any factual inaccuracies in the report. The institution replied on 8 May 2019. All suggested corrections were adopted. Subsequently the final report was endorsed by the panel chair. The panel composed its advice fully independently and offered it to NVAO on 10 May 2019..

2.2 Panel report

The first chapter of this report is the executive summary of the report, while the current chapter is the introduction.

The third chapter gives a description of the programme including its position within the institution, Tilburg University and within the higher education system of the Netherlands.

The panel presents its assessments in the fourth chapter. The programme is assessed by using the standards of the Initial Accreditation Framework. For each standard the panel presents an outline of its findings, considerations and a conclusion.

The outline of the findings presents the objective facts as found by the panel in the programme documents, in the additional documents and during the site visit. The panel's considerations consist of the panel's judgments and subjective evaluations regarding these findings and their relative importance. The considerations presented by the panel are at the basis of a concluding overall assessment.

The panel concludes the report with a table containing an overview of its assessments per standard.

3 Description of the programme

3.1 General

Country	Netherlands
Institution	Tilburg University
Programme	Cognitive Science and Artificial Intelligence
Level	Bachelor
Orientation	Academic
Specialisation	n.a.
Variant	fulltime
Degree	Bachelor of Science
Location(s)	Tilburg
Study Load (EC)	180 EC
Field of Study	Natuur

3.2 Profile of the institution

Tilburg University (TiU) is a public research university, founded in 1927 as a Roman Catholic University. It is centered in the heart of the region Noord Brabant in the south of The Netherlands, rooted in the city of Tilburg. TiU hosts over 13,000 students, 2,000 employees and employs over 270 PhD students. The university hosts over a hundred different nationalities.

Tilburg University consists of 5 Schools:

1. Tilburg School of Economics and Management
2. Tilburg Law School
3. Tilburg School of Social and Behavioral Sciences
4. Tilburg School of Humanities and Digital Sciences (Artificial Intelligence, Communication, Culture, Philosophy, Religion, and Liberal Arts and Sciences)
5. Tilburg School of Catholic Theology

Tilburg University also has a University College, various Graduate Schools and a large number of institutes and research groups.

School of Humanities and Digital Sciences has four departments:

- Communication and Cognition
- Cognitive Science and Artificial Intelligence
- Cultural studies
- Philosophy

The new programme will be part of the Department of Cognitive Science and Artificial Intelligence. The Department of Cognitive Science and Artificial Intelligence already participates in three other Digital Sciences programs:

- BSc Data Science, a joint degree with TU Eindhoven;
- MSc Data Science and Entrepreneurship, a joint degree with TU Eindhoven;
- MSc Data Science and Society (DSS), an inter-faculty programme-at Tilburg University which recently passed the initial accreditation procedure and is now conditionally approved. This programme-has already been offered for several years in the form of the track Data Science: Business and Governance within the CIS program.

At TiU students can choose from a wide range of educational programmes in economics & management, law & governance, communication, culture, and behavior & society. TU offers 69 bachelor's and master's programmes. More than half of them are English-taught. Together with Eindhoven Technical University, TiU offers educational programmes in data science.

According to the university website the mission of Tilburg University is “to understand society and to inspire and challenge students”. The educational programmes focus on students acquiring in-depth knowledge, on training their professional skills, and developing themselves as a person.

Thresholds at Tilburg University are low. TiU likes there to be a great deal of contact between students, teachers and the teams. Classes are taught in small groups whenever possible or feasible. Students and teachers constitute a learning community in which active participation and strong commitment to and in classes are of paramount importance.

3.3 Profile of the programme

In September 2017 Tilburg University started offering a track Cognitive Science and Artificial Intelligence (CSAI) of the bachelor's programme Communication and Information Sciences (CIS). In the academic year 2018/19 the track is in its second year. With the application for a new programme the University wants to turn this track into a programme of its own. The programme will be offered by the Department of Cognitive Science and Artificial Intelligence in the Tilburg School of Humanities and Digital Sciences.

Prior to the CSAI track, the CIS programme offered the Human Aspects of Information Technology (HAIT) track. The HAIT track included several technology-oriented courses (Language, Cognition & Computation, Basic and Advanced Programming and a Research workshop HAIT) but its content was substantially different than the CSAI track in terms of scope, depth and scientific methodology. The HAIT track attracted a limited number of students (ca. 5-10 each year). In sharp contrast, in 2018 the CSAI track attracted 100 students. According to the application file, the curriculum for the current first-year bachelor (BA1) students can be considered a true Artificial Intelligence programme-curriculum, designed in conformity with the KION frame of reference. Apart from minor changes to course names and the addition of two new electives in semester 5, the curriculum for students starting in 2018/2019 is identical to the curriculum of the new program, which is intended to start in September 2019.

The application file explains how the department will cope with students who started in earlier versions of the programme (the CSAI-track of the CIS programme) and want to obtain a diploma for the new programme. Older students will be given the opportunity to follow the new courses within their regular programme and younger students are already offered an adapted programme.

New programme in the Netherlands

There are various Bachelor's programmes on Artificial Intelligence in the Netherlands. The specific focus on Cognitive Science and Artificial Intelligence is not present in these programmes.

New programme for the institution

At the moment a similar programme is offered as a track Cognitive Science and Artificial Intelligence (CSAI) of the bachelor's programme Communication and Information Sciences (CIS). As soon as the programme is accredited it will be offered as a separate programme which is not part of another bachelor's programme.

Credits

The bachelor's CSAI will be a 3 year programme of 180 EC

4 Assessment per standard

This chapter presents the evaluation of the standards by the assessment panel. The panel has reproduced the criteria for each standard. For each standard the panel presents (1) a brief outline of its findings based on the programme documents and on documents provided by the institution and the site visit, (2) the considerations the panel has taken into account and (3) the panel's conclusion. The panel presents a conclusion for each of the standards, as well as a final conclusion.

The assessment is based on the standards and criteria described in the NVAO Assessment framework for the higher education accreditation system of the Netherlands (Stcrt. 2016, nr 69458). Fundamental to the assessment is a discussion with peers regarding the content and quality of the new programme.

Regarding each of the standards, the assessment panel gives a substantiated judgement on a three-point scale: meets, does not meet or partially meets the standard. The panel subsequently gives a substantiated final conclusion regarding the quality of the programme, also on a three-point scale: positive, conditionally positive or negative

4.1 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.

Outline of findings

Appendix A of the application file contains an overview of the intended learning outcomes, divided in the following categories:

- A. Knowledge and understanding
- B. Applying knowledge and understanding
- C. Making judgments
- D. Communication
- E. Learning skills

The learning objectives, and hence the curriculum of the CSAI program, are based on the revised KION framework¹ which was initially developed in 2006 by all Dutch universities offering Artificial Intelligence programmes at that time and updated in 2015 as a result of the recommendations given by the panel of the cluster visitation. Other relevant sources of information consulted during the development of the programme included an extended report on the revised Artificial Intelligence bachelor curriculum at UvA from 2016, a Stanford report on Artificial Intelligence from 2016, and the annual Artificial Intelligence Index.

The programme was presented to and discussed with programme directors and representatives of Artificial Intelligence programmes at Radboud University and the University of Maastricht. According to the application file these confirmed that the programme reflects the KION framework adequately.

The international perspective of the programme is guaranteed by consulting the content of several international programs in Cognitive Science, Artificial Intelligence and related disciplines which are mentioned in the application file.

During the site visit the panel interviewed different groups (dean, lecturers, students and alumni) about the focus of the programme: Is it primarily an Artificial Intelligence programme? Is it primarily a Cognitive Science programme? Or is it a combination of both? All stakeholders agreed that the programme is an Artificial Intelligence programme with a Cognitive Science flavour. Representatives from the field and alumni told the panel that there is not only a need for purely technical people, but also a real need for technical people who not only know how computers work, but also know how

¹ https://www.qanu.nl/sites/default/files/bestanden/files/SOTA_AI_final.pdf

people interact with computers and how computers affect human behaviour and vice versa. Alumni who work in the field feel that the cognitive aspect is also relevant because people in the field more and more have to work in interdisciplinary teams. Therefore, if team members are trained in a multidisciplinary programme, this will enhance the performance of the team.

Considerations

By using the KION framework the programme meets the requirements of the field in Artificial Intelligence. The framework was used by the university to define a specific set of intended learning outcomes which contains many aspects of cognitive science (appendix A of the application file). The intended learning outcomes are verifiably formatted at bachelor's level. They clearly reflect the profile of the programme: An Artificial Intelligence programme with a flavour of CS. The international perspective is guaranteed by benchmarking the programme with some relevant foreign programmes. As the university has intensive contacts with the professional field (e.g. via the regional centre for digital technology Mindlabs and other collaborative projects) and the academic field (e.g. in the joint Data Science programme JADS) the panel is convinced that the intended learning outcomes meet the requirements of the professional field content-wise.

The university has not copied the entire KION framework, but the choices which were made fall within the boundaries of the framework and match the profile of the programme. During the site visit the panel talked to the developers of the programme about the fact that at first sight statistical models (mentioned under "probabilistic models" and "reasoning under uncertainty" in the KION framework) seemed to be lacking. The answers which were given to questions asked about this issue convinced the panel that this is a conscious choice of focus of the programme, and that probabilistic Artificial Intelligence is an implicit part of some modules. On top of this all lecturers will be teaching subjects related to their research and hence bring statistical issues into the classroom.

Conclusion

*The programme **meets** standard 1.*

4.2 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.

Outline of findings

An overview of the programme is presented in the table below. The numbers between brackets indicate the number of ECs for each course.

BA1 S1	Introduction to AI (6)	Introduction to Cognitive Science (6)	Basic Programming (6)	Methodology for CSAI (6)	Introduction to Logic & Philosophy (6)	
	Knowledge Representation (6)	Language, Cognition & Computation (6)	Calculus (6)	Statistics for CSAI I (6)	Professional and Academic Skills (6)	
BA2 S3	Human-Computer Interaction for CSAI (6)	Data Structures and Algorithms (6)	Linear Algebra (6)	Statistics for CSAI II (6)	Web Science (3)	Multi-Agent Systems (3)
	Introduction to Machine Learning (6)	Autonomous Systems (6)	Cognitive Neuroscience (6)	Research Workshop (6)	Ethics of AI (6)	
BA3 S5	Minor –or Mobility Window Programming with C/C++ (elective) Computer Vision (elective) Psychology of Language (elective) Research Internship (elective) (30)					
	Introduction to Deep Learning (6)	Advanced Programming (6)	Computational Linguistics (6)	Thesis (12)		
	Pathway Programming	Pathway Methodology	Pathway Maths	Pathway Machine Learning		

This table (copied from application file appendix B) shows that courses are partly structured into four learning pathways ('doorlopende leerlijnen') each supervised by a coordinating lecturer: Programming, Mathematics, Methodology, and Machine Learning. Courses in a pathway start at the basic level and advance progressively. The last course in a pathway can have an integrative character (e.g., the course Research Workshop in the Methodology pathway). At the site visit the panel talked to the developers of the programme about the fact that many courses are not placed in a pathway and therefore the progression in these courses is less visible. The developers explained that there are some "hidden pathways" in the programme of courses which are connected and there is a build-up throughout the whole programme. The panel was also told that the connection between the track and the other courses is ensured by the fact that there is an adequate consultation between the teachers of the various modules.

Appendix B of the application file shows the relationship between the courses and the topics and skills which are mentioned in the KION framework (p.65-66 of the 2015 document) which are part of all Dutch Artificial Intelligence programmes. Also, one of the additional documents (the assessment plan) shows the relationship between the courses and intended learning outcomes in appendix A of the application file,

Appendix C of the application file gives a short description of each course. It shows that for each individual course learning objectives have been formulated. It also contains information about the literature used in each course. Additional documentation contained some course manuals and a

separate list of literature. In addition, several of the books mentioned in this list and some articles were presented at the site visit. The panel talked to the lecturers about the choice of literature and was told that the programme has chosen to use some 'classic' books (which are in some cases somewhat outdated) in combination with state of the art literature complemented with recent articles.

Admission/ target group

The application file contains the admission requirements for Dutch as well as international students. Compared to the Communication and Information Science programme that is currently offered to students the following requirement has been added: Culture & Society including Mathematics A or B. For students who are studying in the current CSAI track and want to get a diploma in the new CSAI programme this means they have to do some extra courses. The panel was told this is provided for by the university. Some students have already started to catch up on the subjects they miss compared to the new programme. They appeared to be very motivated to get the new diploma. The students also told the panel that the first year of the present track has already been adapted to the new programme.

According to the application file there is a lot of variety in the level of the student population with regard to programming and mathematics at the start of the programme. In order to bring all students at the required level tailor made assessments and extra support are offered for programming. For mathematics the variety is expected to decrease as a result of the new admission criteria.

Didactic principles

According to the application file the programme is built on a balanced mix of theory and practice. Two core characteristics of the programme are **learning by doing** and a **strong research focus**. Examples of the way this is visible in the programme are:

- Practical seminars
- Breakout sessions
- Close relation to existing research facilities
- Participation in hackathons and experiments
- Participation in existing research projects
- State-of-the-art course content
- Focus on innovative research ideas

All examples are explained and illustrated in detail in the application file.

The programme is in accordance with the **Tilburg Educational Profile (TEP)** which means it pays attention to Knowledge, Skills and Character. Skills and knowledge in the fields of Cognitive Science and Artificial Intelligence are extended throughout the curriculum in several disciplinary courses such that by the end of the programme, all KION focus areas will have been covered. The philosophy courses, particularly the course focusing on ethics, contribute to character building, which is an important educational value in all TiU programs.

Student centred

In the third year, there is plenty of room for students to choose their own courses and topics of interest and to widen their academic perspective. The fifth semester is reserved for the so-called 'mobility window'. In this period, students can choose a TiU minor, study abroad, or follow electives at TiU or another Dutch university. TiU offers three relevant minors: Data Science, Entrepreneurship, and Cognitive Neuroscience.

Staff

The staff of the CSAI department consists of researchers who are active in the domains of artificial intelligence, cognitive science, and data science. Members of the department chaired the 2018 Benelearn and Belgium-Netherlands Artificial Intelligence Conferences, participate in the Dutch Special Interest Group Artificial Intelligence, participate in the School for Information and Knowledge Systems (SIKS), and have national and international research collaborations. Appendix E of the application file contains an overview of the teaching staff. CV's of the staff members were provided to the panel.

According to the application file the CSAI Department teaching staff currently consists of ca. 12 fte (20 staff members); an additional 2.8 teaching fte would be filled in 2018/2019. At the site visit the panel

was told that in the meantime another 8 staff members have committed themselves to the programme. Many staff members also work in master's programmes and the joint TiU-TU/e Data Science Bachelor. Since the programme is new, the staff is young and enthusiastic and has state-of-the-art expertise in the field of Artificial Intelligence. The expertise of the staff covers all mandatory courses of the program.

Since 2010, the UTQ (University Teaching Qualification) is compulsory for all teaching staff with a teaching load of 0,4 fte or more. At the moment, 8 members of staff (40%) have passed the UTQ and 6 are in the process of passing the qualification, which will raise the percentage to 70%. At the site visit the lecturers the panel talked to confirmed they were all in the process of getting the UTQ.

Because of the popularity of Artificial Intelligence with both students and teachers the university foresees a possible shortage of lecturers. The Faculty Board recently agreed to announce several vacancies. At the site visit the panel was told that there was a good response of promising candidates.

Facilities

The most important facilities needed to offer the programme are the mentor programme TSHD PASS (Program Academic Study Success), lab facilities and computer facilities. At the site visit the panel had a guided tour at the university during which they had the opportunity to look at the results of different students projects (students participating in the track) and experience the DAF lab in which students can experience AR and VR. There will be a new building in which there will be more labs like this.

English

The programme will be offered in English. According to the Board this was a deliberate choice. Most alumni of the new programme will be working for companies in the southern part of the country and in most of these companies (such as Philips) English is the main language. As a large part of the staff is native speaker of English the level of English of the staff is probably higher than at other universities. Apart from International Law this is the most internationally oriented programme of the university. The Board did not set a target for the percentage of foreign students, but expects part of the student body to be foreign.

Considerations

In general the panel thinks there is a well-balanced programme which covers all intended learning outcomes. The relationship between the intended learning outcomes and the programme is visible in several documents. The panel thinks the pathways are a good way to enhance the coherence in the programme. The different conversations during the site visit convinced the panel that there is a solid consultation structure in place which ensures the alignment of the courses. The panel is very positive about the fact that the programme has its own curriculum committee. As there are many courses which are not visibly part of a pathway (yet), the panel encourages the university to improve the visibility of the coherence between different sets of courses, e.g. by adding more pathways or by somehow indicating the relationship between several courses more explicitly.

When looking at the course descriptions and manuals the panel noticed that the examples given in these manuals are sometimes geared more toward cognitive science than to Artificial Intelligence, as the team is still finetuning the programme. The panel thinks this is an opportunity to put both aspects (Cognitive Science and Artificial Intelligence) in as many courses as possible. For example, in courses about programming and statistics not only examples of cognitive science should be used (as seems to be the case in the current manuals). Examples from statistics in Artificial Intelligence could be added as well. By doing this the programme will become even more a combination of Cognitive Science and Artificial Intelligence, just like the university envisions the character of the programme.

The panel is positive about the fact that there is a lot of practical experience contained in the programme (learning by doing), including an (optional) internship in the second year. At first the panel was a little worried about the feasibility of getting enough places where these internships could take place (employers will not be very keen to have inexperienced students for just a couple of weeks). However, the panel was told that these internships will primarily take place within research projects of the university or e.g. at the Mindlabs. They will be mainly product-oriented. This means the internships will be less dependent on the availability of companies. The panel is very much in favour of this idea.

Both students and lecturers were very positive about the “learning by doing” principle of the programme.

Although not all literature is “state of the art” the panel thinks it suits the programme well. The chosen reference works suit the courses (and most of them are state of the art) and by using many articles and publications the courses will be kept up to date. This will be enhanced even more by the fact that the lecturers are all involved in relevant research projects and will bring the results of these projects into the classroom and on the reading lists.

During the site visit the panel noticed that the members of the team are all very enthusiastic and eager to participate in the new programme. Based on the cvs of the staff the panel is convinced the proposed staff members meet the requirements of the programme very well. Together they cover all subjects in the programme and many of them are very experienced in the field.

A general concern of the panel relates to the fact that the number of students could increase tremendously. Artificial Intelligence is a very popular domain of studies and now there is a formal CSAI programme a huge increase of the student influx is to be expected. Under the present circumstances the panel does not anticipate any major problems regarding facilities, personnel, etc. but if the student population increases to maybe four times the present size the panel foresees problems with recruiting enough staff and maybe also with supplying sufficient facilities. The university is aware of this and a new building is planned, but the panel wants to emphasise the importance of taking this issue very seriously, particularly in light of the intensity of supervision required by the learning-by-doing focus in the programme. As part of the facilities depend on agreements with external parties (Mindlabs) the panel thinks attention for facilities is even more urgent. The Board indicated the importance of this programme for the university as a whole, because it signals a shift in the perception of the image of the university from being traditionally an exclusively alpha-gamma university toward an alpha-gamma university with a flavour of technology. The panel is convinced of the institutional support and trusts this issue will be tackled in an adequate way. Yet, it advises a controlled increase of student numbers to make sure the quality of education remains guaranteed.

One final remark the panel wants to make concerns the fact that responsibilities regarding internal communication and organisation do not seem to be fully crystallised yet. Leadership now lies with the programme director and is embedded well, but a growing programme will require tighter control mechanisms. The panel stresses the importance of paying enough attention to this point.

The panel thinks the university has chosen English as teaching language for the right reasons.

Taking everything into account the panel thinks there is a good, coherent and state of the art programme which will enable students to reach the intended learning outcomes.

Conclusion

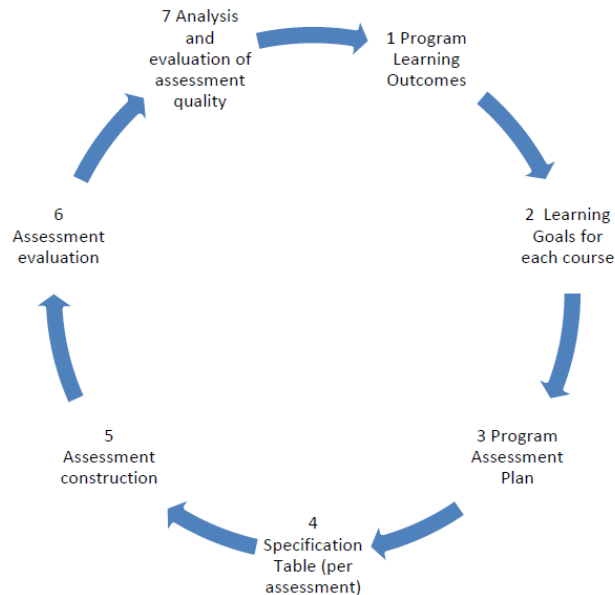
*The programme **meets** standard 2*

4.3 Standard 3: Assessment

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

Outline of findings

Assessments are developed according to the assessment cycle below (application file, p.18):



In the Summer and Fall of 2018, workshops were organised in which future lecturers translated the course objectives into specification tables. Some of these specification tables were available for the panel. These tables link the course objectives to the various components of the assessment to ensure that course objectives and assessment are aligned. Appendix C of the application file (short description of the 1st year courses) shows per course which type of assessments will be used and what the weight of each assessment will be.

To ensure sufficient variation in the assessment methods, an assessment matrix was made that will be updated on an annual basis. This matrix was made available to the panel before the site visit. It shows that the programme uses a multitude of assessment methods. It also shows that each competence is assessed in several modules. At the site visit the panel was told that there is an increase in levels at which the competences are assessed. Generally, knowledge is assessed through written exams and skills through practical assignments. The assessment of the course objectives is monitored by the pathway coordinator and the programme director. The Examining Board (EB) of the Faculty supervises the assessment process. The EB is assisted by five assessment committees (AC), one for each group of programmes. Each committee consists of an assessment expert and two experienced members of staff who have passed the UTQ and are specially trained for this role. The AC works by way of peer review and gives practical support in constructing assessments. Another task of the AC is the ex post course assessment. As soon as CSAI is a separate programme, it will have its own AC. At the site visit the panel talked to members of the EB and the AC about the assessment procedures.

The thesis (12 EC) is an important part of the final semester. It is a project in which students focus on a research question in the Artificial Intelligence field and employ CSAI experimental methodology to offer a quantitative answer. These answers can be provided by both behavioural experiments or computational simulations; combinations of both approaches are also possible. The thesis is supervised by a member of staff who assists the student during the research and writing process and is the first assessor. In addition, there is a second assessor. Both assessors score all criteria independently. The panel studied the thesis guidelines and the rubric used for the assessment of the thesis.

For the thesis project to be evaluated, the following deliverables are required:

- A written report including a reflection on the student's development
- The programming code created in the context of the project
- A demonstrator (short 2-minute video describing the content and outcomes of the project)

For the evaluation of the thesis the following rubrics are used:

- Rubric for assessment of Project Proposal (pass/ fail)
- Rubric for assessment of Poster Presentation (pass/ fail)
- Rubric for assessment of written report (80%)
- Rubric for assessment of the programming code (20%)
- Rubric for assessment of the demonstrator (pass/fail)

According to the application file the programme has taken several measures to avoid plagiarism and free-rider behaviour.

Considerations

The panel thinks there is a thorough system in place to ensure the quality (validity, reliability and transparency) of the assessments. The programme not only contains summative assessments, but many formative assessments as well. The four eyes principles seems to be common practice, not only when grading assessments, but also when developing them. Feedback plays an important role in the assessment system and formative assessments support the learning process. Both the examination board and the assessment committee consist of people who are trained for this job and the staff are all in the process of getting the UTQ. The panel thinks the quality of assessments is safeguarded by a very capable group of people.

The panel looked at four examples of summative assessments. These examples were not representative for the assessment programme as a whole, but judging from these examples the panel noticed a focus on knowledge reproduction questions whilst part of the learning objectives were formulated at a higher (skills) level. The panel has no problems with the multiple choice format of the exams, but recommends the programme to check whether the questions asked are aligned with the learning objectives. Another concern the panel has, is whether the formative assessment (which are not graded) for programming and other skills will ensure that students have sufficient skills when reaching their final project. It recommends strongly to assess (with a grade) the students' level of competencies already before the final project.

The thesis guideline gives a clear description as to how the research should be carried out, what the process looks like and which are the requirements of the report. The rubrics which are used to assess the thesis match the elements mentioned in the guideline and are a useful instrument for the assessors. The panel thinks it's a good thing that there are always two assessors involved in grading the thesis. The panel also likes the idea that it's the ambition to publish the results of the theses at a conference. One thing that is lacking is a (explicit) description of the scope of the research: which are the requirements for the proposal? Which subjects are suitable as research subjects and which aren't? The panel thinks it would be a good idea to add this kind of information to the thesis guideline.

As said in the beginning of this section there is a good system in place to ensure the quality of the examinations, but again the panel wants to express some concern for the future situation in which student numbers will probably be much larger than they are at this moment. This may lead to a more pragmatic attitude by students, in comparison with the very motivated group of students in the current programme. The Examination Board is now made up of members from the Humanities programmes and one member of the Cognitive Science & Artificial Intelligence Department. Considering the expected growth of the programme the panel stresses the importance of an adequate representation of both Cognitive Science and Artificial Intelligence in the Examination Board.

Conclusion

*The programme **meets** standard 3.*

4.4 Qualification and field of study (CROHO)

The panel advises to award the degree Bachelor of Science (BSc) to the Academic Bachelor's programme Cognitive Science and Artificial Intelligence. The panel supports the programme's preference for the CROHO field of study 'Natuur', as all other Artificial Intelligence programmes are classified in the same field and the programme was set up according to the KION framework which is leading for all Artificial Intelligence programmes. The panel describes the character of the programme as "a cognitive science flavoured Artificial Intelligence programme". This justifies the proposed 'Natuur' classification.

4.5 Conclusion

All in all, the panel assesses the quality of the programme as positive.

4.6 Recommendations

The panel gives the following recommendations:

1. The panel encourages the university to pay attention to the examples given and cases used in different courses. In the current manuals examples of Cognitive Science seem to prevail above Artificial Intelligence examples. Giving examples of Cognitive Science as well as Artificial Intelligence in many different courses will enhance the coherence in the programme and will stimulate students to integrate the perspectives of both scientific areas and will make the programme a true Cognitive Science and Artificial Intelligence programme.
2. The panel recommends the university to have a close look at the summative exams in order to see if these are aligned with the learning objectives; e.g. when the learning objectives ask the students to show certain skills the questions asked should also ask about these skills and not for definitions.
3. In view of the expected large interest of students for the CSAI programme, the panel recommends that the programme takes care to strengthen its internal organisation to function on a larger scale. Also in view of the pressure on facilities and other aspects of the learning environment and the reliance on close supervision now in place, the panel recommends a controlled increase in the number of students.

5 Overview of the assessments

Standard	Assessment
Intended Learning outcomes <i>Standard 1 : 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</i>	Meets the standard
Teaching-learning environment <i>Standard 2 : The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.</i>	Meets the standard
Student assesment <i>Standard 3: The programme has an adequate system of student assesment in place.</i>	Meets the standard
Conclusion	Positive

Appendix 1: Composition of the panel

In compliance with the General Data Protection Regulation (GDPR) the details of the CV's of the panel members are not included in the report. Only their current function and/or status is mentioned. Further information on the panel members can be obtained from the NVAO

- Prof.dr. Dirk Heylen, Professor of Socially Intelligent Computing, Department Computer Science, University of Twente
- Prof.dr. Bart de Boer, Professor/researcher, Artificial Intelligence-lab, Vrije Universiteit Brussel
- Dr. Evert Haasdijk, Senior Manager, Deloitte
- Menno van Gameren, Student Future Planet Studies, Universiteit van Amsterdam

Appendix 2: Schedule of the site visit

The panel visited Tilburg University on 3rd April 2019 as part of the external assessment procedure regarding the academic bachelor's programme Cognitive Science and Artificial Intelligence.

In compliance with the General Data Protection Regulation (GDPR) the names of the persons interviewed by the panel are not included in the report, only their function or status. Further information on this can be obtained from the NVAO.

Site visit Wednesday April 3 rd 2019	
9.00 – 9.30	Arrival and welcome
9.30 – 10.00	Session 1: Meeting with the rector magnificus and TSHD board
10.00 – 10.45	Session 2: programme management
10.45 – 11.00	Break
11.00 – 11.45	Session 3: Teaching staff
11.45 – 12.00	Break
12.00 – 12.30	Session 4: Lunch panel and meeting students
12.30 – 13.00	Break
13.00 – 13.30	Session 5: Student cases and projects
13.30 – 14.00	Visit DAF technology LAB
14.00 – 14.30	Session 6: Examination board and program committee TSHD
14.30 – 15.00	Session 7: Alumni and representatives from the field
15.00 – 15.15	Break
15.15 – 15.30	Session 8: Second meeting with programme management
15.30 – 17.15	Panel deliberations
17.15	Brief feedback by the chairman of the panel

Appendix 3: Documents reviewed

Documents presented by Tilburg University (accessible via SURF website before the site visit):

What?	Year	Document number
A. General Documents		
Faculteitsreglement TSHD (in Dutch)	2018	A-TNOCSAI01
Organogram TSHD (in Dutch)	2018	A-TNOCSAI02
B. Course materials		
Literature used in the courses	2018-2019	B-TNOCSAI03
Study Guide Cognitive Science and Artificial Intelligence	2018-2019	B-TNOCSAI04
Course materials from 5 courses	2018-2019	B-TNOCSAI05
C. Assessment		
Procedures Toets- en Examenbeleid TSHD (in Dutch)	2014 ¹	C-TNOCSAI06
Bachelor CSAI Thesis Guidelines	2019	C-TNOCSAI07
Rubric Bachelor Thesis CSAI	2019	C-TNOCSAI08
Assessment matrix	2019	C-TNOCSAI09
Samples of assessment in the new curriculum	2019	C-TNOCSAI10
Bachelor CSAI Minor Guidelines	2019	C-TNOCSAI11
Course manual Research Internship Bachelor CSAI	2019	C-TNOCSAI12
D. Quality Assurance		
Teaching and Examination Regulations (OER) Bachelor 2019-2020 [concept, in Dutch]	2019	D-TNOCSAI13
Minutes Program Committee: course evaluations	2017-2018 2018-2019	D-TNOCSAI14
Guidelines Program Committee TSHD	2018	D-TNOCSAI15
Quality assurance within the program	2019	D-TNOCSAI16
Annual report Examining Board 2016-2017 (in Dutch)	2018 ²	D-TNOCSAI17
E. Strategic plans		
Strategic plan Tilburg School of Humanities and Digital Sciences 2018-2021	2017	E-TNOCSAI18
F. Curricula Vitae Teaching Staff		
G. CDHO and TNO documents BA CSAI		

Appendix 4: List of abbreviations

Ba	bachelor's degree
CSAI	Cognitive Science and Artificial Intelligence
EC	European credit point
hbo	professional higher education
Ma	master's degree
NVAO	Accreditation Organisation of the Netherlands and Flanders
wo	Academic orientation

The panel report was ordered by NVAO for the initial accreditation of the programme wo bachelor Cognitive Science & Artificial Intelligence of Tilburg University

Application no.: 007729



Nederlands-Vlaamse Accreditatieorganisatie
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