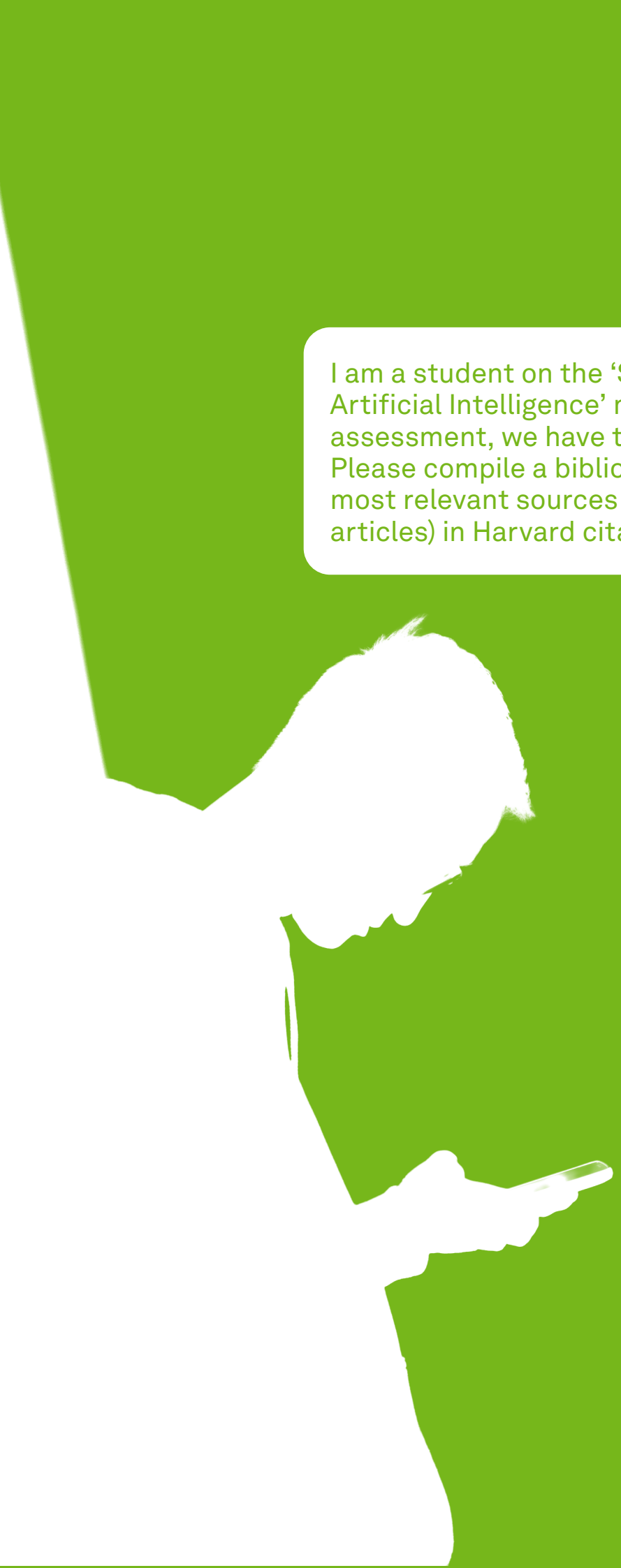




Handout

BENEFICIAL USE OF ARTIFICIAL INTELLIGENCE

Version: August 2026



I am a student on the 'Spatial Planning and Artificial Intelligence' module. As part of the assessment, we have to write a term paper. Please compile a bibliography listing the five most relevant sources (peer-reviewed academic articles) in Harvard citation style.

Here is a selection of frequently cited peer-reviewed articles on the subject of spatial planning and artificial intelligence:

Batty, M. (2018): Artificial intelligence and smart cities. *Philosophical Transactions of the Royal Society A*, 376(2128), 20180020.

Yigitcanlar, T., Desouza, K.C., Butler, L. & Roozkhosh, F. (2020): Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature. *Journal of Urban Technology*, 27(2), pp. 3–29.

Miller, H.J. & Goodchild, M.F. (2015): Data-driven geography. *GeoJournal*, 80(4), pp. 449–461.

Wang, J. & Yuan, Y. (2021): Machine learning-based approaches for urban land-use and spatial planning: A review. *Cities*, 112, 103144.

Zhang, C., Li, W. & Travis, D. (2019): Gaps and opportunities in deep learning-based urban land-use classification. *Remote Sensing of Environment*, 232, 111301.



FOUR OF THE FIVE PROPOSED SOURCES DON'T EXIST IN THE SPECIFIED FORM!

Thanks, dear LLM!

Unfortunately, because of
you, I've failed my seminar and
have to retake it next term.



INTRODUCTION

Artificial intelligence (AI) is on everyone’s lips! Spatial planning is no exception and is influenced by AI in a variety of ways. We look forward to helping you explore these interconnections in greater depth throughout your degree programme in a wide variety of course contexts! This guide focuses not only on subject-specific content, but also on the relationship between the use of artificial intelligence and your academic success.

The way in which you study and learn is interlinked with artificial intelligence tools. These tools are not merely a technical phenomenon; they also shape social and cultural practices, and thus the process of education itself. This gives rise to both opportunities and risks. This guide aims to raise your awareness of the interplay between learning and AI and to support you in using AI tools effectively to enhance your academic success. The focus is on how you can integrate AI into your everyday student life in a reflective, responsible, and beneficial way.

The introductory (real-life) example above of using an LLM illustrates the tension between the opportunities and risks of artificial intelligence in the context of learning. On the one hand, the LLM can act as a useful source of suggestions when simply searching for interesting literature. The information provided includes references to real, relevant authors and supplies important specialist terms. On the other hand, the example also illustrates various risks. Some of the generated references contain incorrect or fabricated bibliographic details and are therefore not reliable for use in their current form. How helpful AI is in literature review depends on how confident you already are in conducting research. If you have already mastered the targeted search for academic literature, AI can be a useful aid. However, if you are still developing this skill, taking a shortcut via AI may mean that important learning steps are missed.

Opportunities and risks are often closely intertwined and must be carefully weighed up depending on the situation. The aim of the following explanations and illustrations is to help you develop a sense of this.

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SOURCE:

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THE AI LEARNS FOR ME!

*The journey is what matters.
Knowledge only sticks when
you work it out for yourself.*

THE LEARNING PROCESS

Learning involves more than simply absorbing and reproducing information. It is an active process of understanding, examining, applying and reflecting. University study is about tackling subject-specific problems independently, critically evaluating information, constructing sound arguments and drawing well-founded conclusions (Buck 2025; Voss 2026). AI can support you in this by, for example, answering comprehension questions, summarising texts, providing feedback, suggesting translations or offering alternative perspectives and examples (Marczuk et al. 2025). However, it does not replace your subject-specific understanding or your responsibility for decisions, arguments and submitted texts (Buck 2025; Voss 2026). You remain responsible for your learning process: you define the problem, set goals, select tools, provide context, critically review results and, ultimately, take responsibility for both the work process and the outcome (Buck 2025).

LEARNING PROCESSES CAN BE DIVIDED INTO FOUR PHASES:

1. INFORMATION ACQUISITION

The first step in the learning process is information acquisition. This stage is not a purely passive activity, but already involves actively comparing new information with existing knowledge. This involves an initial assessment of its relevance, coherence and potential contradictions. AI tools can serve as a stimulus at this stage, for example to gain an initial overview of a topic, formulate comprehension questions or identify key terms. AI can provide particularly useful support during initial orientation, with routine tasks and in structuring information (Buck 2025). The content provided by AI should not be accepted uncritically, but should serve as a starting point for independent research and expert scrutiny (Voss 2026).

2. COMPREHENSION

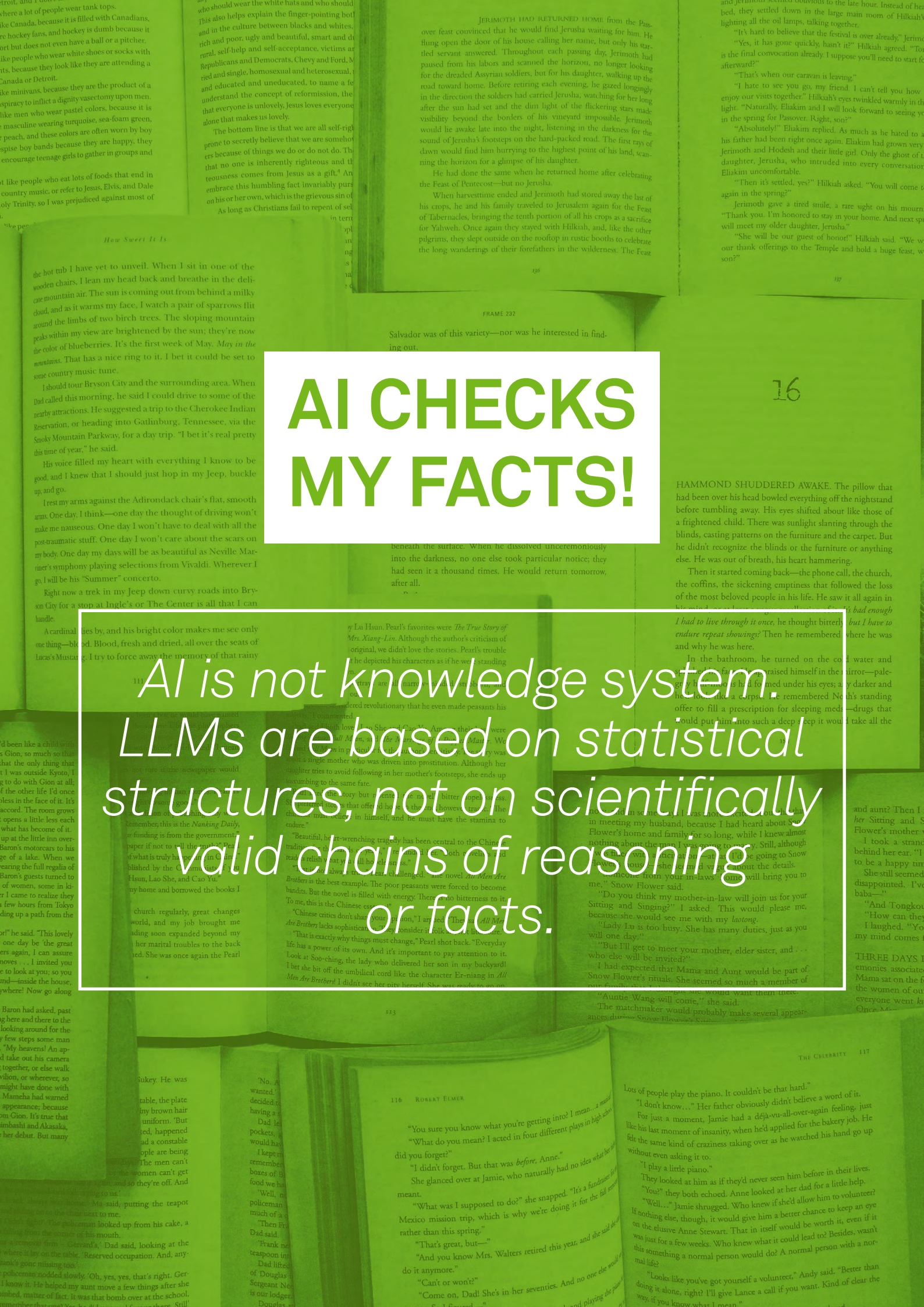
Following the initial review comes the particularly crucial phase of understanding: new information is integrated into existing mental frameworks; if it does not fit, existing concepts must be adapted or new ways of thinking developed. Understanding means more than simply being able to repeat information. It means being able to explain connections, causes, concepts and consequences. AI can help by explaining difficult concepts at different levels of difficulty, asking follow-up questions or providing examples and counter-examples. AI can be particularly beneficial for learning if you use it as a thinking partner, for example by having the AI ask follow-up questions, offer alternative arguments or encourage you to reflect on your own assumptions. However, the task of subject-specific evaluation remains yours: you are in charge of assessing whether explanations are accurate, what conditions they are subject to, and which aspects may be missing (Buck 2025; Voss 2026).

3. APPLICATION

The structures established in Step 2 are not yet permanently consolidated. Knowledge continues to develop when it is transferred and applied to familiar and, in particular, new situations. This reveals any gaps in understanding and highlights new questions for further information-seeking. AI can assist in developing exercises, case studies, transfer questions or alternative application scenarios. AI is particularly well-suited to generating variations, providing initial feedback and structuring more complex tasks, provided that the results can be verified in terms of subject matter. The solution, reasoning and subject-specific assessment must be developed and checked by you yourself (Buck 2025; Voss 2026).

4. REFLECTION AND CONSOLIDATION

By repeatedly applying the first three steps, knowledge is consolidated over longer periods and anchored in long-term memory. In this phase, you reflect on your own learning strategy in order to learn in an even more targeted way in the future: What have I learnt? Which approaches were helpful, and what should I change next time? AI can serve as a reflection aid here by assisting with the creation of a learning plan or suggesting alternative learning strategies. It can also simulate feedback on one's own text, line of reasoning, or solution, thereby highlighting ambiguities, missing justifications or possible counter-arguments. However, the final assessment of your own level of learning and the decision as to which topics require further study remain with you (Buck 2025).



AI CHECKS MY FACTS!

AI is not knowledge system. LLMs are based on statistical structures not on scientifically valid chains of reasoning or facts.

BASIC PRINCIPLES OF GENERATIVE AI

Generative AI systems do not generate content by looking up information as in a dictionary and verifying its accuracy. Rather, language models predict, step by step, which text unit (e.g. a word or part of a word) is most likely to follow next in the given context. The results are thus based on statistical patterns derived from training data and the current conversational context. A model therefore primarily generates formulations that appear linguistically appropriate and plausible. However, this does not automatically mean that the statement is factually correct, up to date, complete or substantiated by sources. AI systems do not possess their own understanding in the human sense and cannot guarantee that their answers are true or factually correct. They can therefore also generate errors that sound convincing, inappropriate conclusions or non-existent references (Voss 2026). Furthermore, AI systems do not provide a complete and neutral representation of all available information. Which perspectives, sources and topics are highlighted depends, amongst other things, on training data, technical selection mechanisms and the not entirely transparent functioning of the respective systems (Benert & Timmermann 2026). AI responses can therefore reproduce or reinforce existing asymmetries in attention: perspectives that are frequently visible, readily available or heavily represented in the training material may predominate over less visible perspectives (Benert & Timmermann 2026).

WHAT DOES THIS MEAN FOR HOW I USE AI?

If you bear in mind the basic principles outlined above, you can use AI in a targeted and productive way. Generative AI is particularly good at identifying linguistic patterns, varying phrasing, structuring texts or offering initial ideas and perspectives. You can therefore make good use of AI tools to revise texts linguistically, develop alternative phrasing or obtain feedback on structure and clarity (Marczuk et al. 2025).

AI can support you in your academic work and enhance your writing process, but it neither replaces your own thinking nor your responsibility as an author (Buck 2025). Particularly when it comes to facts, academic statements, references and conclusions, a plausible formulation is not in itself proof of their accuracy.

- ✓ You can use AI for linguistic polishing, structuring or to generate alternative wording suggestions.
- ✓ Always check AI-generated statements, figures, quotations and sources against reliable original or specialist sources.
- ✓ Only use AI-generated results if you have understood them from a subject-matter perspective, evaluated and, where necessary, revised them.
- ✓ Take responsibility for your text and your line of argument: you decide which statements are convincing, what evidence is required and which conclusions you support.

**IT'S ALL ABOUT
'WRITING IT DOWN
NICELY'.**

The writing process supports thinking through sensorimotor processes. Write texts yourself and use AI only for the final polish.

WRITING AS A THINKING TOOL

Writing is more than a mechanical act of putting thoughts into words. It helps you to develop ideas, structure knowledge, examine arguments and arrive at new insights. In academic work in particular, writing is therefore not merely the presentation of a finished result, but an essential part of the process of gaining knowledge (Buck 2025).

1. WRITING MAKES THOUGHTS VERIFIABLE

Thoughts may initially be vague, incomplete or contradictory. Only when you translate them into comprehensible sentences, paragraphs and arguments do these thoughts become verifiable for yourself and others. When writing, you must clarify terms, explain connections, select evidence, and justify conclusions. This can reveal ambiguities, contradictions or unfounded assumptions in your own thinking (Buck 2025). Discussions also fulfil this function, as they force you to formulate your own position clearly and to respond to queries or counter-arguments.

2. WRITING RELIEVES THE WORKING MEMORY

We cannot always think about everything at once. In academic contexts in particular, trains of thought can quickly become extensive and complex. Writing helps to organise information, concepts and lines of argument, and to record the results of your thinking. You can use notes, outlines, sketches and first drafts to visualise and deepen your current line of thought. This means you do not have to keep all aspects in mind at once and can examine the relationships between individual arguments more consciously.

3. WRITING STIMULATES THE BRAIN TO NEW THINKING PROCESSES

Writing is an iterative process. As you formulate your ideas, you often notice new connections, unanswered questions or alternative perspectives, so that you are continually engaging with your own train of thought. The search for appropriate terms and a convincing argumentative structure can lead to your original assessment changing or evolving further. Academic writing is therefore also a means of actively processing knowledge, rather than merely reproducing it (Buck 2025). Furthermore, through your own writing, you learn how to argue, quote, structure and communicate in a way that is appropriate for your audience in spatial planning. This professional socialisation is an important part of your degree programme.

WHAT DOES THIS MEAN FOR MY USE OF AI?

In academic writing, AI is particularly useful when it supports your own writing and thinking process, rather than replacing it with a finished text. For example, it can help you check an outline you have already developed for clarity, improve transitions between sections, compare alternative phrasing, or raise questions about your line of argument. The order is important: first develop your own ideas, draft a version, and then use AI specifically for revision or as a critical sounding board. This way, writing is a process in which you develop arguments, recognise connections and refine your position (Buck 2025).

AI can also simulate feedback, for example by pointing out unclear terms, gaps in reasoning, missing justifications or possible counter-arguments. These suggestions are not a judgement on the quality of your text, but can help you revise it in a more targeted way. The AI's role is therefore primarily to support your writing process: it can provide food for thought, alternative ideas and feedback. The decisions about which arguments to put forward, how to justify them and which version to submit remain yours (Buck 2025; Voss 2026).

PRACTICAL RECOMMENDATIONS:

- 

Create your own outline. Use AI, if necessary, to identify gaps, alternative arrangements or issues with clarity in your existing outline, rather than letting the AI generate the entire structure without checking it.
- 

Start by writing your own rough draft. Incomplete or linguistically unpolished expressions are normal and helpful in this stage, as they highlight where your understanding, reasoning or source analysis still has gaps.
- 

Revise in a targeted manner rather than across the board. Do not simply instruct the LLM to 'improve' the entire text; instead, focus on specific aspects such as clarity, sentence structure, redundancies, paragraph logic or the central theme.
- 

Compare different phrasings critically. If AI suggests alternative phrasings, check whether these accurately reflect your intended message, are appropriate to the academic style, and do not alter the content.
- 

Separate linguistic feedback from academic scrutiny. AI can provide guidance on presentation, but it cannot reliably determine whether an argument is technically correct, a piece of evidence is appropriate, or a conclusion is tenable.

**THIS IMAGE DOES NOT
YET EXIST!**

*The legal status of AI-generated
images remains unclear.
You should therefore use AI-
generated images carefully.*

AI-GENERATED FIGURES

AI-generated images are a tempting alternative to the time-consuming process of creating your own professional graphics. They can illustrate complex issues or serve as creative inspiration, but they present legal, ethical, academic, and content-related challenges (Voss 2026).

1. COPYRIGHT INFRINGEMENTS CANNOT BE RULED OUT

Copyright protection presumes an act of personal intellectual creation. An image generated entirely automatically is therefore not automatically a copyright-protected work of the person who entered the corresponding prompt. This may be different if you substantially shape an image through your own creative decisions, for example through a deliberate concept, the selection from among several variants, or extensive post-processing of your own (Voss 2026). Nevertheless, copyright issues may arise in relation to AI-generated images. Image-generating AI systems are often trained using large image datasets, which may, at least in part, contain material protected by copyright. The legal assessment of the use of such training data has not yet been conclusively clarified in many respects (Voss 2026). The resulting image may also be problematic if it bears a striking resemblance to a specific existing work or recognisably imitates protected elements, trademarks, characters or visual styles.

2. AI IMAGES ARE INDIRECTLY BASED ON HUMAN CREATIVE WORK

The legal situation also has an ethical dimension. Behind the training data lie numerous creative contributions by photographers, illustrators, designers and other creators. Whether, and in what form, these individuals have consented to the use of their works or are being remunerated for them is often not transparent. When using AI images, you should also consider the circumstances under which they were created. Do not treat AI-generated images as if they were created entirely independently of human creative work, but label them transparently as such (Voss 2026).

3. AI IMAGES CAN BE MISLEADING IN TERMS OF CONTENT

A convincing-looking image is no proof that what is depicted is real, historically accurate or scientifically substantiated. AI-generated images may contain inaccurate details, implausible proportions, stereotypical depictions or factually incorrect contexts. This is particularly problematic when an image appears to be a photograph, a documentary or a scientific illustration, even though it is merely a synthetically generated illustration (Voss 2026).

4. CREDIBILITY IS AN IMPORTANT ASSET

The credibility of your work may also suffer if an image contains recognisable errors, inappropriate details or gives a misleading impression. Such anomalies may give readers the impression that the image – and possibly other content in the work – has not been carefully checked. Conversely, AI images that appear particularly flawless or heavily staged may seem inauthentic and raise doubts as to whether the depiction shows a real observation, an illustration or a scientifically substantiated statement. You should therefore not use AI images as evidence of real circumstances, historical situations, research findings or empirical data. Instead, make it clear that these are AI-generated illustrations, and check carefully before use whether the image content, design and message are appropriate for your academic context (Voss 2026).

5. TRANSPARENCY AND ACCOUNTABILITY

In an academic context, there is also an academic issue to consider. Anything you use in a piece of work without citing it is regarded as your own intellectual output. If you use an AI-generated image, you should therefore follow the guidelines set out by your course, the faculty and, where applicable, the examination regulations. Regardless of how the image was technically created, you assume responsibility for not misleading, legally sound and suitable for the respective context.

WHAT DOES THIS MEAN FOR MY USE OF AI?

AI-generated images can convey complex issues clearly. Use them primarily as clearly labelled illustrations, not as a substitute for real sources, your own data collection or verifiable scientific visualisations.

- ✓ Carefully check every generated image for errors in content, implausible details, stereotypical representations and misleading visual statements.
- ✓ Examine AI-generated graphics carefully and, if necessary, use a reverse image search, such as the one offered by Google Lens, to identify any possible similarities with previously published or copyright-protected works.
- ✓ Use AI-generated images sparingly and, where possible, create your own sketches, diagrams of the subject matter you are presenting, because you have to decide which information
- ✓ Label AI-generated or substantially AI-edited images in a transparent manner. Furthermore, always follow the regulations and guidelines issued by the examination board to avoid issues relating to examination regulations.

THE IMAGE LOOKS PERFECTLY FINE!

AI tends to amplify existing biases. This is due to the way it fundamentally works and depends heavily on training data and algorithms.

REPRESENTATIVENESS, BIAS AND BALANCE

‘AI is a completely neutral, computer- and statistics-based tool with no intentions of its own.’ At first glance, this seems plausible. Whilst AI systems do not make decisions based on their own intentions, their results are not value-neutral. Generative AI is developed by humans, trained on selected data, governed by rules and feedback, and provided by companies within specific technical and economic frameworks.

These are models trained on large volumes of data and are therefore heavily dependent on their data set. Training data may reflect social norms, historical inequalities and existing biases. Furthermore, certain groups, regions and life experiences may be under-represented or not taken into account at all (Voss 2026). If a dataset primarily represents certain perspectives and/or biases, these may be reflected in the results of an AI and further reinforced through its use. Such biases, which may well be exacerbated, can arise, for example, from unbalanced data, from decisions made during the design of an algorithm, or from human assessments during model training. The same applies to the subsequent generative procedures, which are not free from human decisions and are therefore only objectively limited.

Selection and visibility mechanisms also play a role: AI systems may favour content and perspectives that occur particularly frequently in their data or are readily accessible. This can reproduce or reinforce existing asymmetries in attention. It often remains difficult for you to understand which data, weightings, safety rules and selection mechanisms have influenced a specific response or image generation. This limited traceability is one reason why AI results should not be treated as a neutral representation of reality. Behind many tools lie large companies with a commercial profit motive. Whilst this is not in itself reprehensible, it can influence which functions, content, sources or security requirements are prioritised.

WHAT DOES THIS MEAN FOR MY USE OF AI?

In AI-generated data, certain groups, regions, life experiences or specialist viewpoints may be over-represented, whilst other perspectives may be less frequently visible or entirely absent (Voss 2026). This applies not only to images, but also to texts, examples, translations, summaries, research suggestions and AI-assisted assessments. A carefully worded prompt can reduce bias, but it does not guarantee complete representativeness or freedom from discrimination.

- ✓ Examine the perspective suggested by an AI result. Ask yourself which assumptions, groups of people, regions or viewpoints are highlighted, and which may be missing.
- ✓ If necessary, rephrase your prompt to obtain a more balanced result. Deliberately request alternatives, e.g.: “List different specialist perspectives on this question and highlight how they differ.” or: “Which groups of people, regional contexts or opposing viewpoints might be missing from this presentation?”
- ✓ Compare several results and sources. Create several versions, use different prompts or tools, and cross-check key statements against academic sources, databases or original documents.
- ✓ Also reflect on your own choice from the alternatives presented. Decide consciously why you are accepting a particular AI result, which alternatives you are rejecting, and whether your choice confirms your own expectations or well-known stereotypes.
- ✓ Ask yourself regularly: Have I already become accustomed to this type of result, or am I reflective enough to realise that I should scrutinise the result with regard to its potential to reinforce standardising, distorting or (in the worst case) prejudice-promoting tendencies?

CONCLUSIONS

The above explanations and points illustrate that AI can have both positive and negative effects on your learning process. It is your responsibility to use these still relatively novel tools to your advantage. Should reading this guide have sparked your interest in the beneficial use of artificial intelligence in your studies, we strongly recommend that you consult our separately published overview of AI tools, which you can download from the Department of Spatial Planning's website. In it, you will find brief descriptions of a large number of AI applications from a wide variety of fields that are suitable for use in planning. We also recommend the book by Thomas Sanchez, which focuses specifically on the intersection of planning and AI; you can find it in the bibliography below. We wish you every success in your studies – whether or not you use artificial intelligence!

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