INTEGRATIVE SUSTAINABILITY EDUCATION: EMERGING CONCEPTS AND APPROACHES

Innovative education for wicked problems: An impact study of the Wageningen University Honours Programme

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ABSTRACT
Despite the growing consensus that academic curricula should play a crucial role in addressing wicked problems, academic curriculum designers often find themselves entering uncharted waters. This impact study addresses a number of challenges in the search for how innovative ways of learning affect students’ ability to deal with wicked problems. The empirical research focuses on the case study of the Honours Programme of Wageningen University and draws on interviews with early career alumni. The concepts “agency” and “boundary spanning” are considered guiding principles to prepare students to cope with complexity and uncertainty, unreliable information, conflicting interpretations and non-transparent cause-effect relationships. This study finds that participation in the Honours Programme resulted in students developing agency in (1) ownership; (2) self-reflexivity and (3) shaping focus and boundary spanning between (1) disciplines; (2) people and (3) theory & practice. The study concludes that innovative education characterized by freedom, long-term projects, and real-life challenges can contribute to students developing agency and boundary spanning capacities.

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1. Introduction
It is common knowledge that sustainable development challenges have become ever more pressing. Indeed, climate change, biodiversity loss, and zoonotic diseases are not distant threats but realities today (IPCC 2021). “Many decisions over major environmental risks do not involve a choice between safe and risky alternatives, but one between different risky alternatives, and often a choice between alternatives whose risks concern different dimensions which are barely mutual measurable (Beck 2007, pp. 3–4)”. Given these challenges, the search for sustainable solutions to environmental risks implies dealing with complexity and uncertainty, unreliable information, conflicting interpretations and non-transparent cause-effect relationships. Consequently, there is a call for new roles for and new relationships between scientists, policy-makers, private sectors and civil
society and a demand for innovative decision making and implementation strategies (Van Buuren and Hendriksen 2010; Termeer and Dewulf 2019).

Rittel and Webber (1973) introduced the term “wicked” to describe highly complex problems, distinguished by three dimensions: 1) knowledge uncertainty; 2) value conflict; 3) dynamic complexity. While literature has widely adopted the definition introduced by Rittel & Webber, studies have focused in particular on the intractable and dynamic nature of wicked problems (Dentoni et al. 2018). Less attention has been paid to the role of education in relation to wicked problems. Despite the growing consensus that academic curricula should play a crucial role in addressing current and emerging sustainable development challenges, academic curriculum designers often find themselves entering uncharted waters (Lotz-Sisitka et al. 2015; Warwas 2015; Bovill and Woolmer 2018).

Koppenjan & Klijn (2004) posed that wicked problems require professionals to engage in collaborative and cross-disciplinary activities in multi-stakeholder contexts. According to Hanstedt (2018) universities play a crucial role in educating students who have a sense of the world around them and of their ability to interact in that world in meaningful ways. Recent literature shows progress has been made in implementing various innovative education approaches such as design thinking (Panke 2019; Cooke et al. 2020; Earle and Leyva-de la Hiz 2021; Matthews et al. 2022), project-based learning (Kłeczek et al. 2020), problem-based learning (Tomkinson 2011; Dobson and Tomkinson 2012; McGibbon and Van Belle 2015; Thomassen and Stentoft 2020), academic consultancy (Fortuin and Bush 2010), and community-based research (Cantor et al. 2015). Yet there is not much focus on how such innovative approaches prepare students to participate in collaborative efforts to tackle wicked problems (Dentoni et al. 2018).

This study researches how honours programmes may contribute to address wicked problems. The main research question for this study is formulated: How do innovative ways of learning impact the capability of students to engage with wicked problems? The impact analysis is based on the concepts of agency and boundary spanning.

This empirical research focuses on the case study of the Honours Programme of Wageningen University. It draws on interview data with alumni of the first cohort of the Honours Programme of Wageningen University. In 2014, the programme started with 30 Bachelor’s students. Most students from this first cohort obtained their Master’s degree in the academic year 2018–2019. The decision to research the first cohort was made because these individuals have the longest professional experience (about 3 years), allowing for data collection on post-graduation impact of the Honours Programme. Explorative interviews were carried out with 5 supervisors of the Honours Investigation Projects. Based on the results of these interviews and building on literature, a topic sheet was developed for semi-structured interviews. 15 Honours alumni have been interviewed. Based on interview data, a qualitative impact analysis was performed. Key emerging themes were iteratively identified through loose coding and (re)interpretation of categories.

Section 2 discusses the concepts of agency and boundary spanning and their relevance to studying the impact of the Honours Programme of Wageningen University in relation to wicked problems. Section 3 provides an overview of the Wageningen University Honours Programme, the case study. Section 4 presents the results on how innovative education impacts students’ agency and boundary spanning capacities. Finally section 5 draws conclusions on the main research question and synthesizes the overall findings.
2. Agency and Boundary Spanning

To make sense of knowledge, experiences and capabilities required to understand and address wicked problems in the context of education, the concepts of boundary spanning and agency are crucial (Head 2008; Williams, 2013; Veltman et al. 2019; Akkerman and Bakker 2011; Bell et al. 2014). Both concepts are at the heart of the qualitative analysis of how academic programmes prepare students to work on wicked problems. Literature on boundary spanning and agency in the context of education and wicked problems is developing, yet still at an early stage (Varpio et al. 2017; Veltman et al. 2019).

Boundary spanning can be understood as the capacity to “enter new territory” and “face the challenge of negotiating and combining ingredients from different contexts to achieve hybrid situations” (Akkerman and Bakker 2011). This translates into capabilities to question and redefine separations between systems, engage across these systems, see one’s perspectives and practices in a new light, and develop new cross-cutting practices (Akkerman and Bakker 2011). These capabilities have the potential to enable individuals to deal with the complex nature of wicked problems (see, amongst others, Termeer et al. 2015).

Agency refers to the (perceived) capacity of an individual to reflect on and articulate intentional choices and translate these into actions within complex social, political, and economic dynamics (Bell et al. 2014). Agency of individuals is an important factor in dealing with, rather than being overwhelmed by, wicked problems. It facilitates new forms of leadership and collaboration, which have been identified as key to address wicked problems (Head and Alford 2015). Varpio et al. (2017) argue that theories of agency can provide insightful novel perspectives on tackling wicked problems in the context of education. Agency emphasizes the role of the individual as a starting point for change through intentionality and reflexivity.

The concepts of boundary spanning and agency are used to iteratively organize and analyse the empirical findings. The impact study relies heavily on both concepts.

3. Honours programmes: a case study in the Netherlands

3.1 Context

Honours programmes have become part of higher education systems around the globe, and an increasing number of students are enrolled in such programmes (Long and Mullins 2012; Kool et al. 2017). These programmes aim at facilitating students to fully enhance the development of graduate attributes and to ultimately contribute to both science and society. Honours students are assumed to have the potential to excel in their future professional lives (Scager et al. 2012; Jansen and Suhre 2015). In addition to these shared learning objectives, there is enormous variation within honours programmes worldwide, but also within Europe or even within the Netherlands. Generally, honours programmes in the UK and Australia comprise of an additional research project that students can do at the end of their Bachelor degree. In the Netherlands, honours programmes typically commence in the first or second year of a bachelor degree, last multiple years and comprise of various elements.
There is much variation in terms of multi-, inter- or trans disciplinarity; variation in selection methods, duration, size, assessment methodologies and content of the programmes. This is the main reason that this paper focuses on one case study, the Wageningen University Honours Programme, to measure the impact on a specific group of honours graduates.

In the Netherlands, honours programmes were initiated and further strengthened by the Dutch government (2008–2015) through a competitive grant programme. Their aim was to serve highly talented students with more challenging education provision and to enable universities to experiment with new educational approaches.

Innovative education needs an innovative assessment structure. Honours students are graded with a pass or fail, no marks are given. The assessment for the in depth assignments and the Honours Investigation Project is done by involved (associate) professors of Wageningen University. The activities and personal development trajectories are reviewed by Wageningen University experts in the field of reflection, personal growth, process guidance and empowerment. Students have to write reflection papers and during the Honours trajectory students develop their own portfolio. After approval of the portfolio by the Honours team, students receive an Honours certificate.

The general idea behind the honours programmes is to encourage talented students who are capable of developing new knowledge and applying these innovations as citizens, employees or entrepreneurs (Klemencic, 2021). Despite their rapid increase, the added value of honours programmes remains largely under-researched (Wolfensberger 2012). In order to justify the existence of honours programmes, research is needed into the impact of these programmes.

### 3.2 Case selection

The case study of this paper is the Wageningen University Honours Programme, which is aimed at students who want and are able to go the extra mile. Three characteristics were vital for the selection of a case study to research the impact of an university honours programme: (1) a university with a focus on developing knowledge to design applicable sustainable solutions for the major sustainable challenges faced by the world; (2) access to the group of honours students, who are currently post-graduates; (3) the possibility of data triangulation should be ensured. The Honours Programme of Wageningen University has met the above mentioned characteristics.

### 3.3 Wageningen University Honours Programme

The Wageningen University Honours Programme is a two-year extra-curricular programme with a workload of 30 credits (840 hours), which is done by students on top of their regular bachelor study programme. There is one honours programme for the entire university. In line with other Dutch honours programmes, the Wageningen University Honours Programme consists of three pillars: broadness, in depth, and personal development.

First of all, the broadness pillar exist of two components: the Honours Investigation Project and Honours Activities. The Honours Investigation Project is a two year project that forms the backbone of the Honours Programme. In interdisciplinary teams of 5–7 students, students develop a self-defined deliverable. Examples of the final product can be a design,
4. Results: Education for wicked problems in practice

Based on interviews with supervisors and alumni, six themes emerged. Figure 1 shows the six themes, relating to agency (themes 1–3) and boundary spanning (themes 4–6) that form the results of the case study. For each theme it is explained how it came forward in the interviews in the form of personal development (left circle) and research skills (right circle).

4.1 Agency

Examining the experiences of agency, three themes emerged: ownership, self-reflexivity, and focus. The paragraphs below analyse the journey the alumni undertook to develop their agency in different ways.
Interview data shows that students felt substantial ownership over their learning experience, with responsibility, proactivity, and perseverance emerging as important themes. Eight out of fifteen interviewees made comments related to responsibility, proactivity, and perseverance. In the programme, students received substantial ownership over an open-ended two year Honours Investigation Project and the individual assignments. Alumni emphasized that this meant they needed to take responsibility for both their learning experience and the final result, encouraging them to be proactive and manage time and resources wisely. Two alumni described how they developed more proactivity and confidence, as the Honours Programme pushed them and showed them what they were capable of. For example, one alumna described:

‘I’ve always found it difficult to approach people, but the Honours Programme provided me with the little push I needed to learn that, because I for example needed to discuss possibilities for extra assignments with teachers.’

**Figure 1.** Agency and boundary spanning in the Honours Programme.

### 4.1.1 Agency as Ownership: Responsibility, Proactivity and Perseverance

The Honours Programme encourages students to take ownership of their learning experience through responsibility, proactivity, and perseverance. The programme provides an open-ended two-year Honours Investigation Project and individual assignments, allowing students to develop a sense of ownership and control over their learning. Alumni highlighted the importance of taking responsibility for both their learning experience and the final result, which motivated them to be proactive and manage their time and resources wisely. Two alumni shared how the programme pushed them to become more proactive and confident in their learning:

‘I've always found it difficult to approach people, but the Honours Programme provided me with the little push I needed to learn that, because I for example needed to discuss possibilities for extra assignments with teachers.’
Alumni mentioned that the Honours Programme provided the extra challenge they were looking for besides their Bachelor but they also highlighted that participating in the programme was far from easy. The extra 30 credits was experienced as a substantial workload on top of the regular study programme and some alumni mentioned that in practice even more time was spent on the Honours Programme. As one alumna described:

‘The Honours Programme brought me perseverance, because it was very time intensive and it wasn’t always easy to finish everything on time.’

Despite the high workload, students did have a lot of discretion over what activities to engage in and how to shape their projects. Alumni described how this freedom in combination with the responsibility to deliver results prompted them to be proactive and resourceful in carving out solutions to implement one’s ambitions.

‘In Honours I really developed a proactive attitude and the skills to do something with it. An attitude to be active, organize things and use my network and skills to set up events, developing an idea or integrating feedback’.

“Agency as ownership” summarizes students’ feeling of being prompted to be proactive, take responsibility and persevere in the face of challenges.

### 4.1.2 Agency as Self-reflexivity: Exploring Strengths, Weaknesses and Interests

Self-reflexivity emerged as an important theme based on interviews with alumni and supervisors. Eight out of fifteen participants made reference to reflection in the interviews. One of the interviewees noted that the Honours programme was the first time she was asked to reflect on learning experiences, noting that this was not common in her high school and Bachelor’s education. She noted that learning how to reflect on experiences has been very valuable for her after the programme, particularly during her board year and in the selective traineeship she currently pursues.

As already touched upon above, the team experience is prominent in the Honours Programme. Alumni noted that they developed a more reflective attitude in terms of their own functioning in a team. Moreover, several alumni noted that they learned to reflect more on how they perceive and react to perspectives and inputs from others. This realization allows for more meaningful and respectful interactions.

Many alumni mentioned how the programme allowed them to explore and ultimately find what interested them most, both within and outside their own discipline. For many alumni, this impacted their choice for a specific Master or job after their Bachelor. For example, one of the alumni mentioned:

‘I chose for this traineeship because it is set up very broadly like the Honours Programme, I still like to look beyond my own field.’

Another alumnus explained how all the activities he carried out under and outside the Honours Programme showed a pattern in that they were all related to setting up new projects and initiatives. This self-awareness contributed to his decision to do a master in innovation management.

Yet another Alumnus shared that the Honours Programme helped him to discover his passion for research. He mentioned that this early realization of the direction in which he wanted to develop his career, helped to compound further learning and experiences
effectively towards his research career goals, *inter alia*, resulting in academic publications during studies.

“*When I started Honours, I was ‘young and searching’. Honours, amongst other things, helped me to find out that I liked practical research, which is what I do for a living know*”.

Agency is closely related to reflection. Interview data indicates that a reflective attitude characterized by continuous evaluation of one’s ambitions, values, and actions is nurtured in the Honours Programme. The intensiveness of the programme forces students, sooner or later, to make tough choices and “say no” to opportunities every now and then. The ability to transform self-reflexivity into action by shaping one’s focus will be discussed in the below section.

### 4.1.3 Agency as Shaping Focus: Knowing Boundaries and Setting Priorities

Learning to shape focus in projects, the Honours Programme, and life after Honours emerged as a theme from the interviews. Five out of fifteen students discussed how the Honours Programme helped them to know boundaries and set limits. Although the majority of the interviewees did not bring up this topic, those who did mention it, described it as a topic that was very influential for them. As described previously, the Honours Programme is a substantial time investment on top of the regular studies programme, hobbies, and social activities. This led students to explore their boundaries and set limits, both on a small scale level (in projects) and on a larger level (in their personal lives).

For example, one of the alumni valued learning about time management and setting priorities within a project:

> *I learned a lot about planning by doing the two year project, especially to keep track of time and to not make a project bigger than it needs to be.*

Alumni recall that they reached a point where their agendas were simply overflowing, forcing them to set limits and make choices in their life on a larger scale. Some alumni explain how they enjoyed this busy lifestyle and constantly searched for ways to effectively manage their time. One alumnus mentioned that he could keep up with the busy schedule during the Honours Programme and that this provided him with preparation to guard limits in his professional life.

Throughout the Honours Programme, students are challenged to take control of their own process of knowledge acquisition. For some students, this has been a transformational experience that triggered them to set priorities differently in their future lives. For example, two alumni noted that during the Honours Programme they decided to deliberately avoid an overly busy lifestyle in the future. Importantly, one of these alumni highlighted that the Honours Programme did confirm for her, her interest in learning and exploring. Yet, she intentionally opted to organize this learning differently in the future. That is not via institutionalized programmes and projects, but rather in self-initiated forms that do not have strict deadlines and reporting requirements.

> *Honours was very valuable for me, but after the programme, I realised I didn’t want to be the career tiger that does a million different things. During my master I put less attention on my career and more on socialising and friends*”

Other students discovered their interest for a particular topic is great enough to make this topic a priority later in their life. For example, one of the alumni described how,
through several smaller projects, he was able to learn how to use the CRISPR-Cas technique, which proved to be very useful as he used this technique in several other internships and projects.

“The smaller projects were the most valuable and fun for me, as they gave me the opportunity to get lab experience, learn to program and expand my thesis. This lied the basis for me to get involved in the research field, I am currently in”.

Taken together, students did not only learn to take ownership and engage in reflection, they learned to transform these insights into action by shaping their future actions. Throughout the Honours Programme, alumni were encouraged and enabled to shape their focus within projects as well as within the programme itself, and for some this benefitted them both professionally and personally later on in their life.

4.2 Boundary Spanning

Examining alumni’s experiences with boundary spanning, three themes or in this case, boundaries, emerge. These relate to boundaries between people, disciplines, and those between theory and practice. Below the students’ journey of engaging with and developing capacities to span these boundaries is analysed.

4.2.1 Boundary Spanning between People: Respect, Understanding and Trust

Alumni indicated that the Honours Programme helped them to develop the skills needed to overcome boundaries they encounter while working with people from different (disciplinary) backgrounds and with different personalities. Twelve out of fifteen interviewees highlighted team working skills as an important learning result of their participation in the Honours Programme. Most interviewees highlighted the Honours Investigation Project as the most important element of the Honours Programme that provided them with the opportunity to develop team working skills, such as communication, leadership, and dealing with different personalities. Many alumni emphasized that the two-year duration of the project was instrumental to realizing these learning outcomes.

‘You need to work together for two years, which really is an experience. In short term projects, it’s okay if collaboration doesn’t go that well. But in this long project you have to make it work, because you need to continue together.’

Alumni highlight that, beyond disciplinary differences, the Honours Investigation Project showed them the importance of mutual respect and understanding in team projects. Alumni highlighted that over the course of the project, they learned to listen better to others and respect their inputs.

‘Working together with people with different backgrounds made communication more difficult at times, but also more valuable. The added value of getting to understand each other’s perspective, as well as trusting in the expertise of others are important in the project.’

Moreover, alumni noted that they learned how to leverage the qualities and expertise of each of the group members for the collective benefit of the project. This includes placing trust in others. For example, one alumnus noted that during his regular studies he often took over tasks of other group members who did not perform well. However, he noted that during the Honours Investigation Project, all students were motivated, and the
project was too big to take over the work of others. Instead, he had to trust others to complete their tasks.

While it may not be surprising that engaging in a team-based project results in the development of team skills, many alumni stressed that this particular project was different from the team projects in their regular studies. The two-year duration is a critical element here that facilitates students to cross boundaries and develop respect and trust rather than to “sit it out” or “take over” the project as they may normally do when collaboration does not run smoothly.

The next paragraphs will further elaborate how working together with people from different academic disciplines, allowed the alumni to span boundaries between disciplines. Through learning how to span boundaries between people with different backgrounds and personalities, the alumni indicated this allowed them to really get an insight into the academic disciplines of their peers and ultimately enabled them to critically think about a problem while taking all different perspectives into account. Disciplinary differences emerged prominently from the interviews and will be discussed in more detail below.

4.2.2 Boundary Spanning between Disciplines: Developing a Broader Perspective & Critical Thinking

Engaging across disciplinary boundaries was a central element of the Honours Programme according to alumni. Thirteen out of the fifteen interviewees made remarks in their interview about crossing disciplinary boundaries in one way or another. Interviewees emphasize that the Honours Investigation Project “forced” them to work together with students from other disciplines, ranging from social sciences to the natural sciences. In some instances, this caused discomfort and feelings of being misunderstood. One participant described how she was the only social science student in the group. She described difficulties she experienced at the start of the project, which was qualitative research. Her team members were focused on getting measurable results while this was not compatible with the qualitative character of the research. Initially, she felt like her inputs were not valued and taken seriously. Yet as the project progressed she felt team members were able to span boundaries between people, and a mutual understanding for viewpoints of others developed.

This experience is confirmed by a group member, who had a natural science background. He recalled how the Honours Investigation Project allowed for deep discussions where there was ample time to learn about the backgrounds of other persons which ultimately results in a greater understanding and respect for those who come from other disciplines. He described that this experience is still of much value in his current work:

‘Processing and analysing what and how people say certain things in what context and with what background and intention was very valuable for me. This is still a very relevant perspective to keep in mind, especially now with the increase in digital (mis)communication during Corona.’

Beyond simply respecting other people’s viewpoints, many Honours alumni also described that they themselves broadened their perspective and enhanced their critical thinking. One alumnus described how the Honours Investigation Project showed him the importance of looking at a problem from multiple angles and ultimately critically evaluating the weight that should be given to each of these. During the Honours Investigation Project this alumnus participated in, various stakeholders brought in different
perspectives that all needed to be taken into account. The alumnus reflected that in the company he currently works for, the focus is rather narrowly defined in terms of economic indicators. While he personally reflects on choices of the company from a systems perspective, it remains difficult to make this land in the company.

While this alumnus experienced it could be challenging to put the boundary spanning between different fields into practice in his current job, many alumni indicate that the Honours Programme enabled them to experience how to put the “academic” into practice in the outside world. The next paragraphs highlight how alumni used their newly acquired multidisciplinary knowledge and skills.

4.2.3 Boundary Spanning between Theory and Practice

The Honours Programme allows students to work on real-world projects and deal with various stakeholders. This is a crucial aspect in ensuring that alumni experience crossing boundaries in real-world settings which involve other people, be it in a professional or personal environment.

‘During your Bachelor, the end goal is to provide you with knowledge about your field. The Honours Programme takes it one step further: Knowledge is your starting point, not the end goal. You are encouraged to practically connect knowledge with different disciplines and the actual society.’

Honours Investigation Projects involve different stakeholders and address a concrete problem in society. For example, some of the students worked for two years with a municipality to tackle the problem of salinization. These students felt they contributed to the solution of the problem, while gaining experience with boundary spanning between different stakeholders and disciplinary fields.

‘There were many different stakeholders, from the municipality, local farmers to the tourist association, they were all involved. Apart from providing a technical solution, we took social implications into account and we were able to bring these stakeholders closer together, while taking all of their problems into account from a holistic perspective.’

Alumni mentioned how some of the outcomes of their Honours Investigation Projects and other assignments had a positive impact outside of the university and research community. They highlighted how the programme challenged them to think of ways to span the boundaries between university and its surroundings, by making their research and findings accessible to the outside world. For example, some students translated their thesis findings into an easy-to-understand article for lay people. Other students organized events or distributed research findings in books or magazines. For example, one of the students gave a public lecture in the local library about hydrology and another student wrote books about organic food and distributed them in local stores. Yearly, the Honours students also organize an event to share their Honours Investigation Projects with the wider community through organizing a public symposium.

Alumni continue the journey in their current workplaces where they work with people and ideas from different disciplines. For example, one alumna currently works as a teacher at an interdisciplinary study programme that crosses boundaries of social, economic and environmental domains in the study of coastal systems.
Another alumnus works as a management consultant, spanning boundaries between highly specialized IT experts and the company’s management. Yet another alumnus works along boundaries of economic and environmental indicators in the context of product development in a large food company. The above examples illustrate how alumni have to work across boundaries as recently graduated knowledge workers.

Some students expressed disappointment with the lack of focus on the “product” or the deliverables. Some entered the programme with the expectation that delivering high-quality products was the central goal, but ultimately learned most in terms of managing the process. For some this “unexpected” outcome was satisfactory while others indicated they would not re-enrol in the programme had they known about this process orientation. Yet other students did feel that the Honours Programme allowed them to develop in-depth knowledge and quality products, including through programming or lab work. A modulating factor seems to be the extent to which students manage to self-organize. At any rate, expectation management seems to be an important element and it should be noted that the process-oriented set up of the programme can also result in some students feeling their expectations are not being met.

Another finding is that the intensive learning experience of the Honours Programme may come at a cost. Many students indicated that participation in the programme was demanding and oftentimes stressful. Beyond simply the workload, some students felt strong pressure to perform and live up to the “honours” status of the programme. With concerns over mental health of students rising (Auerbach et al. 2016), it may be warranted to further explore how novel educational forms can be implemented in a way that better take into account mental health concerns. One option may be to replace rather than add extra work on top of existing programmes. However, some students enjoy the “extra” element and challenge of a higher workload. Similarly, the “prestigious” status is experienced by some students as essential to open doors.

5. Conclusion and discussion

In this impact study, a number of challenges have been addressed in the search for how innovative ways of learning affect students’ ability to deal with wicked problems. The concepts “agency” and “boundary spanning” are considered guiding principles to prepare students to cope with complexity and uncertainty, unreliable information, conflicting interpretations and non-transparent cause–effect relationships.

Based on the findings of this impact study, the operationalization of Agency in (1) ownership; (2) self-reflexivity and (3) shaping focus shows that participation in the Honours Programme prompted students to take responsibility, be proactive and persevere in the face of complex challenges while at the same time students are invited to critically reflect on their own roles, values and actions. Students are encouraged to experiment and explore new methods and approaches embracing failures and flexibility.

This has long term effects in students’ professional and personal lives.

Boundary spanning distinguishes crossing boundaries between (1) disciplines; (2) people and (3) theory & practice. While working in interdisciplinary project settings and
addressing complex challenges, many honours students noted the value of experiencing underlying values and methodologies used by peers from different backgrounds and disciplines. Meaningful collaboration is seen as essential to navigating wicked problems, whose complexity and uncertainty naturally cross disciplines and value systems. Collaboration with societal stakeholders’ give meaning to the concept of science for impact and stimulates students to span their boundaries between the academic world and societal impact.

Implementing innovative educational approaches is promising but also challenging. The balance between freedom and tailor made learning trajectories and ensuring that all students receive quality education is particularly complicated. Further research is needed to examine how such approaches may be scaled up and made available for a larger number of students.

**Lessons learned**

To prepare students to contribute to solutions for wicked challenges, innovative education programmes should include the concepts of freedom, long-term projects and real-life challenges.

The set-up of the Honours Programme is such that students have substantial room to make their own choices with regard to how to shape their learning experience. Yet this freedom is not free of obligations and expectations. Indeed, Honours Programme students are required to obtain a certain number of credits and there is substantial (perceived) pressure to deliver high-quality outcomes. In any case, students ultimately hold the ownership over the project and activities they engage in. While one may argue that this is a risky approach that cannot guarantee high quality learning outcomes for all, students have perceived it to facilitate the development of agency and boundary spanning as it forced them to make choices, take responsibility and explore their strengths, weaknesses and ambitions. In other words, the freedom, and the encouragement to explore new terrains, has promoted agency. The challenge for educators is to guard diversity of participating students and exploring ways in which this form of education can be mainstreamed in regular degree programmes.

Importantly, ownership and freedom is set in the context of a long-term collaborative project with students from various disciplines. Here, long-term engagement is a key success factor. The lengthy duration of the Honours Investigation Project was what necessitated students to cross boundaries. Whether it is peers or stakeholders with radically different working styles or disciplines, the long exposure and necessity to understand each other, is what alumni indicated to enable them to develop boundary spanning capacities.

Apart from introducing the students to different disciplines, the programme enabled students to explore the world around them through engaging with real-life challenges. This provided students with the opportunity to connect theory to practice and span boundaries between actual stakeholders with different perspectives and interests. In programme, students were familiarized to work on projects that addressed wicked problems with real stakeholders. Students had to pro-actively find solutions themselves and manage difficulties as they emerged.

This impact study, drawing on interviews with alumni, shows how innovative education characterized by freedom, long-term projects, and real-life challenges can contribute to students developing agency and boundary spanning capacities. With socio-environmental
challenges becoming increasingly pressing and wicked, it is timely to implement innovative education solutions that will empower students to address complex challenges.

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Ethics declarations

All participants provided informed consent before participation in the study and interview data was anonymized. Review of this research project by the Social Sciences Ethics Committee of Wageningen University & Research was not necessary as per Wageningen University & Research regulations and Dutch law.

Data Availability Statement

The data that supports the findings of this study are available from the corresponding author (M. van Deursen) upon reasonable request.

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