Students' Exploration of Elective Courses in Flexible Higher Education: Findings From a Digital Simulation Task

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Flexible higher education requires students to compose individual learning routes by selecting elective courses. Such choice-making processes can induce stress and procrastination and thus demand effective guidance. This exploratory mixed-method study examines the students' use of a digital tool to support them during exploration-in-breadth, the initial phase of educational choice-making processes. Bachelor students (n = 49) used a prototype that enabled browsing, filtering, and shortlisting electives. Trace log data and sequence analysis captured interaction patterns, including time-on-task, filter use, and selection behaviour, while a survey assessed motives, usability, and support needs. Results show that students display diverse navigation behaviour and that such a tool can facilitate structured exploration, particularly through filtering before shortlisting favourites. Students valued the tool for orientation but indicated the need for personal guidance when making final decisions. These findings support the potential for integrating asynchronous digital exploration with synchronous mentoring (blended guidance). Design implications include adaptive technological support, integration of mentor dialogue, and explicit development of students' choice-making competencies.

Keywords:
flexible education, technology-enhanced learning, choice-making processes, exploration task, sequence analysis

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1 Introduction

Higher education (HE) is undergoing a significant shift towards flexibility, a trend illustrated by the prominence of flexible education in the EU Strategic Agenda for Higher Education (EC, 2017). Two main goals of flexible HE are 1) accessibility to better accommodate an increasingly diverse student population, and 2) adaptability to better prepare for future jobs (Jonker et al., 2020). Flexible education, such as the integration of elective courses in the curriculum, is seen as an approach that offers students the opportunity to take more responsibility for their own learning as well as the opportunity to choose education that matches their own interests (Wade, 1994). The ability to make choices based on individual interests is associated with higher academic performance and better well-being. Moreover, it is deemed necessary to remain motivated (Harackiewicz et al, 2008; Schulz et al., 2018).

Research into the needs of students regarding flexible education also shows that they wish for more flexibility than they experience (Huizinga et al., 2022). In addition, they indicate that they need guidance in making such choices (Huizinga et al., 2022; Bolhuis et al., 2020). Choice overload and decision-making anxiety can discourage young people to make a choice at all ("The paradox of choice"- Schwartz, 2016). To date, there is insufficient knowledge of how educational institutions implementing flexible education can support young people in making choices for elective courses to construct their own learning path (Van der Stappen, 2022).

2 Related work

2.1 Choice-making processes

The Dual Cycle Model outlines the process of identity formation of young adults and involves several choice-making tasks (Figure 1). This model shows which steps are part of a well-informed choice making process. Indeed, conscious choice-making activities contribute to identity formation: *I know what I want* (Luyckx et al., 2006; Zimmerman et al., 2015; Germeijs et al., 2006). Insight into your 'internal compass' provides direction for the choice-making process, and to the required information, to make a well-considered choice (Meens, 2020). A well-informed choice, in turn, leads to a satisfactory choice (Meens, 2020; Zimmermann et al., 2015). Having to make well-informed choices is difficult and might lead to stress and procrastination

(Meens, 2020; Schwartz, 2016). Therefore, students need support in exploring the set of options they can choose from.

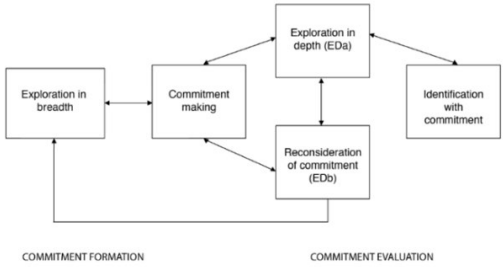

Figure 1: Choice-making process according to the Dual Cycle Model
Source: (Luyckx et al., 2006; Zimmerman et al, 2015)

Research on decision-making processes has identified five styles (Scott & Bruce, 1995). Students can adopt 1) a *rational style*, in which the student displays strong engagement and arrives at a clear choice with conviction; 2) an *intuitive style,* in which the student does not engage in extensive orientation, but still chooses with confidence; 3) an *avoidant style*, in which the student prefers to postpone or even avoid making a final decision; 4) a *dependent style*, where the student seeks extensive help and advice from others; or 5) a *spontaneous style*, characterised by spontaneous and impulsive choices. Which style – or combination of styles – a person adopts for a particular choice depends on their personality, the type of choice, and their previous experience with similar choices. Although the use of digital tools to support students' exploration and choice-making has increased, little is known about how students with diverse choice-making styles can be supported with such tools. This lack of insight hampers the development of effective support mechanisms, both within the digital environment and in face-to-face guidance.

2.2 Digital support tools

During the choice process to select an elective course, students evaluate their internal compass and seek and weigh information about the options they can choose from. Digital tools have the potential to support students, e.g., by scaffolding the process, navigating all options in a structured way, or accessing the required knowledge and insights independent of time and place (Smarius & Van der Stappen, 2022).

This study builds on two previous design-based studies (Smarius & Van der Stappen, 2022; Van Brussel et al., 2025). First, design propositions for digital support tools were developed, accompanied by two prototypes implementing these propositions, to support students in the early phase of the choice process known as *exploration-in-breadth* (see Figure 1; Luyckx et al., 2006; Zimmerman et al., 2015; Germeijs et al., 2006). Next, design propositions for blended guidance were developed and a prototype of an arrangement of guidance activities to support the entire choice-making process. The current study uses a software prototype that emerged from two prototypes of the study by Smarius & Van der Stappen (2022).

This study answers the following research question: *How do students use a digital support tool to explore elective courses, what motivates their selections, and what additional support do they need to make well-informed choices?* Based on the answers, we formulate design implications for technology-enhanced and personalised support of choice-making processes of students in flexible higher education.

3 Method

This study followed an explorative, mixed-method approach, in which students performed a simulated exploration and choice-making task (Dooley, 2002) and subsequently completed a survey. The survey consisted of 14 items (See Appendix B). From the prototype application described in the previous section, we retrieved the trace log data to investigate student interaction and navigation behaviour in the tool.

3.1 Participants and sample size

The study was conducted at a Dutch higher education institute that offers students the opportunity to compose 25% of their curriculum with elective courses (the first elective is scheduled in the third quarter of the second year). Participants were full-time students from six departments within the institution. Academic staff recruited these students; all students were active members of an academy council. The choice tool was provided online and students logged in anonymously. All participants signed an informed consent form, explaining why and how their data was collected, analysed and stored in a secure environment. Fifty-five students from different

domains logged into the tool, 49 completed the simulation task, of which 44 students completed a survey.

3.2 Procedure

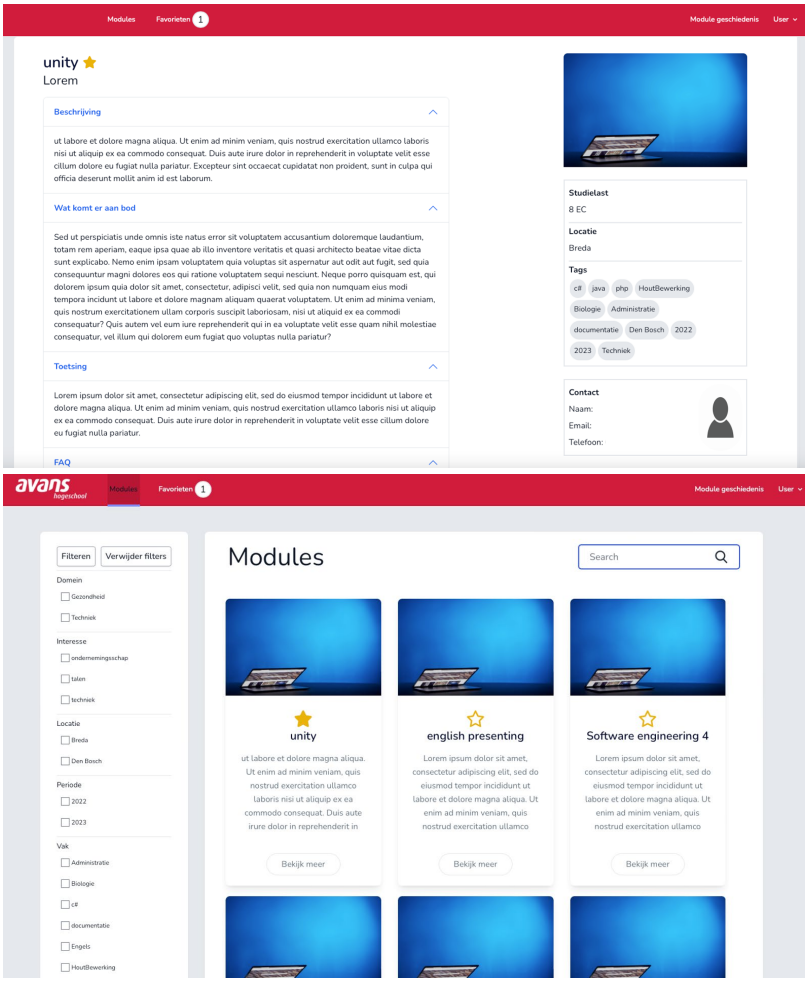

Figure 2: Screenshots of the tool used in this study

Tool design. The elective course portfolio of 211 elective courses that is offered in the upcoming years was imported into the digital tool (see Figure 2 for screenshots, displaying mock data). The simulation tool allowed students to browse, filter, and

mark elective courses (termed Modules). Students logged in and were able to choose between two tiles which were presented on the overview page: Modules and Favourites. In the Modules section, an overview of the 211 courses in the portfolio was shown (Figure 2, left). By clicking on the tile for a specific course, more detailed information about the course was shown (Figure 2, right). It was possible to mark a course as favourite both from the detailed information and from the overview page. Students were able to filter by single or multiple tags, with the possibility to add and remove filters during the session (see Appendix A for the filters).

Within the 'Favourites' tile it was possible to search, remove, and navigate the marked courses. It was also possible to see the courses that the student previously marked as favourite but that they later removed (history page).

The simulation task. Participants were asked to explore elective courses and compile a shortlist, as if they were choosing an elective for their next semester. The task was to first mark NLQF-5 level courses they would like to explore further, and subsequently NLQF-6 courses. In both tasks, students marked their favourite courses with a star, and this list could be adjusted during the whole task. There was no minimum, maximum or preferred number given for the favourite courses students could select.

Analysis. To examine students' interaction patterns with the digital simulation tool, we conducted a descriptive analysis of logged trace data. The dataset included clicking behaviour, filter usage, and marking and unmarking of favourites. We calculated mean, median, range, and standard deviation for the number of courses marked as favourite and time spent in the tool (time-on-task). We compiled sessions per student based on a time limit of 90 minutes; for five students, a second session was found, all consisting of at most 13 clicks. We removed these sessions as their timestamps did not correspond with the scheduled timing of the simulation tasks. Finally, we performed a sequence analysis in R (Saqr et al., 2024; Valle Torre et al., 2024) using the TraMineR package (Gabadinho et al., 2011), to explore variation in navigation behaviour and to identify clusters of how students engaged with the tool during the exploration-in-breadth phase.

Finally, students were asked to complete the survey consisting of 14 items (Appendix B). Categories were the number of items on each shortlist (Q1,2), motives to mark courses as favourites (Q3,4, 5,12,13), information needs during the choice-making process (Q6,7,8), usability of the choice tool (Q9,10,14), and the student's current academy (Q11). We analysed the survey data quantitatively by determining the mean and median (Q1,2), the current academy (Q11), and the total percentages of each answer option (Q3,4,6). We qualitatively analysed the open answers given to Q5 and 7–14. We analysed deductively, based on the relevant literature.

4 Results

On average, participants marked 5.6 elective NQLF-5 courses as favourite (*SD* = 2.85), and 5.8 NQLF-6 courses (*SD* = 2.99). The median in both levels was 5, and the range of marked courses was 0-20 for NQLF-5 (*SD* = 4.84), and 0-15 for NQLF-6 (*SD* = 3.69). Two students marked no favourites at the NQLF-5 level and four (different) students marked no favourites at the NQLF-6 level. From the 211 elective courses, 35 were never marked as favourite. The top three courses that were marked favourite were:

1. Introduction to Psychology (12 times – NQLF-5)
2. Data-driven decision-making with AI (10 times – NQLF-6)
3. Cybersecurity (NQLF-5) *and* International Project Management & Stakeholder Engagement (NQLF-6), both 8 times)

4.1 Filters and search terms

We cumulatively counted which filters students used. Most used were filters related to the 'domain' (440 times) and 'level' (421 times) of electives, followed by 'location' (270 times). The domain filter referred to the educational domains of the university, e.g., 'Technology & Engineering' (94) or 'Economics' (85). The filter for courses that transcend domains ('Cross-sectoral') was used 43 times. The NQLF-5 and NQLF-6 filters were used 256 and 161 times, respectively. The 'type of cooperation' filter (e.g., monodisciplinary or multidisciplinary) was used merely 12 times. See Figure 3 for an overview of the chosen filters.

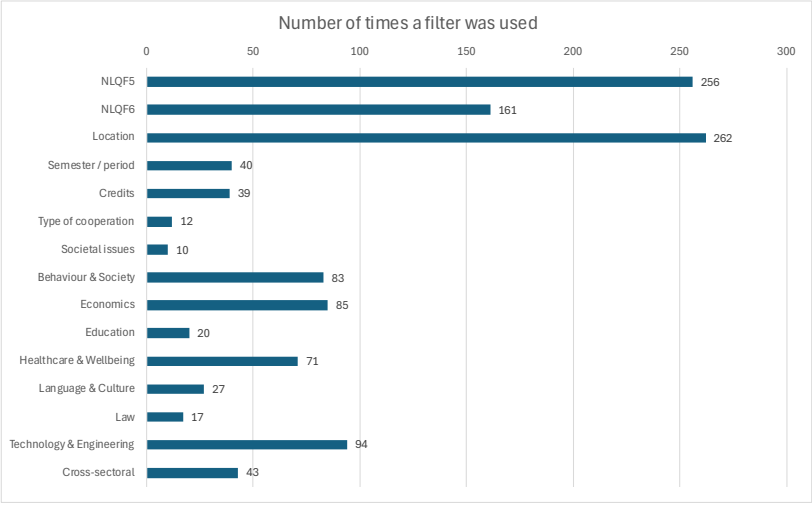

Figure 3: Overview of the chosen filters.

Search terms were used less than filters. An analysis of the search terms showed that 'care' and 'health' were used most (32 and 21 times, respectively), followed by 'innovation' (6), design, AI, research, and project (4), impact and management (3). Furthermore, 72 search terms were used only a single time (e.g., serious gaming, artistic, sustainability, and finance).

4.2 Trace data

Sequence analysis of the trace log data reveals the behavioural patterns that students displayed when interacting with and navigating in the tool. A total of 42 distinct sequences were analysed. On average, students spent 45.23 minutes in the online environment (SD = 20.4), with a median of 41.01 minutes, and a range spanning from 9.7 to 88.2 minutes. Overall, interaction with the tool was heavily centred on filtering operations and viewing the module overview. Across the entire dataset, the highest average time was spent in the 'Filter' state (mean = 89.28 seconds) and navigating to 'Filter -next page' (mean = 58.83s), followed by viewing the modules themselves (mean = 49.91s). We mapped the chronological sequence of eight distinct states (e.g., Filter, Show details, Favourites) for each student. Using optimal matching to calculate substitution costs and applying Ward's hierarchical clustering method (Ward, 1963; Murtagh & Legendre, 2014), three distinct behavioural profiles emerge (see Figure 4):

- **Cluster 1: Rapid Explorers (n = 20).** This largest group is characterised by the shortest average time-on-task (M = 36.5 minutes, SD = 17.8). These students spent a moderate amount of time setting filters (mean state time = 61.8s) and subsequently navigating module lists (mean state time = 26.8s) or viewing detailed descriptions (mean = 26.5s) before making a selection. Their sequences show straightforward progression from filtering to evaluating details, mostly resembling the intuitive choice-making style.
- **Cluster 2: Deep Evaluators (n = 15).** Students in this cluster spent significantly more time (M = 52.8 minutes, SD = 17.6) and used the filter options most (mean state time = 136.27s) and extensively reviewing module overviews (mean = 93.40s). Their behaviour mostly resembles the rational choice-making style where students view and adjust parameters across a wide breadth of options before adding items to their shortlist.
- **Cluster 3: Prolonged Browsers (n = 7).** This smallest cluster records the highest average time-on-task (M = 53.9 minutes, SD = 25.0). These students spent an overwhelming proportion of their session navigating to subsequent pages of search results ('Filter -next page'; mean = 140.71s). Furthermore, they spent less time reading specific module details (mean = 21.71s). This pattern shows superficial exploration behaviour, where students browse expansively through paginated lists, mostly resembling the avoiding style.

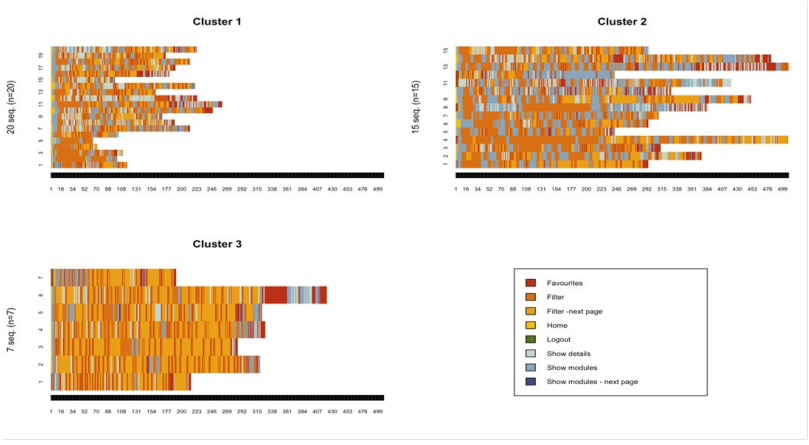

Figure 4: Overview of all distinct student sequences per cluster. Each row represents one student's session.

4.3 Survey insights

A total of 44 students completed the survey after using the tool for the simulated choice task. The participants were students from three different educational domains, namely Economy (n=19), Technology & Engineering (n=14), and Health & Education (n=11).

We asked participants to rank the reasons to choose the courses that they shortlisted based on importance (Q3). The most frequently ranked reason for adding an elective course to the shortlist was personal interest; 39% of students ranked this for their first choice and this reason remained influential across subsequent choices. Other prominent factors included professional development (18% for first choice) and perceived usefulness (14% for the first choice).

In addition, we asked participants to rank other important reasons to choose the courses they shortlisted (Q4). These included additional motivations such as broadening knowledge (55% for first choice) and deepening expertise (55% for second choice), suggesting that students value both diversification and specialization. Less common reasons included alignment with personal values, talents, and future study or career goals, which appeared in later choices. Only 2% of the students indicated that the possibility of following the course online influenced their decision to put a course on their short list. Elective courses were most often excluded because they did not align with students' interests, professional development needs, or learning objectives, or because the information provided was insufficient. Location and unclear descriptions were also mentioned as barriers.

Regarding the information needs to make a well-informed choice, 43% of the students requested more detailed course descriptions, including learning objectives, workload, assessment methods, and teaching formats. Furthermore, 23% indicated a need for personal guidance, such as conversations with a coach or course coordinator, while 20% wanted clearer information about the overall choice-making process. A small minority (7%) reported relying primarily on intuition and not requiring further details.

5 Discussion

Based on the qualitative and quantitative results, we see that students apply different interaction patterns during a simulated task related to exploration-in-breadth (Scott & Bruce, 1995; Meens, 2020); the three clusters we found aligned most with the intuitive, rational and avoiding style. However, it also might be that the simulation tool and the assignment stimulate certain behaviours over others, e.g., completely avoiding the choice process was not an option in the experimental setting. Moreover, the simulated exploration had no clear decision constraints, trade-offs, or consequences. Still, some students might rely on intuitive or dependent choice styles, indicating the need for adaptive tools that cater to different decision-making styles (Scott & Bruce, 1995; Meens, 2020). Further research might explore the relationship between choice style, information need and choice behaviour, which could lead to the development of a more adaptive choice tool that suits all types of choice makers.

Regarding what motivates students, the results show that the elective courses that are marked as favourite meet students' personal interests, professional development and deepening or broadening knowledge. It is therefore important that students have insight in their internal compass (their interests, values and goals – Meens, 2020). Discovering their internal compass should therefore be considered as part of a (blended) guidance program. Practical information must be concise but complete (e.g., location, credits, assessment description). These conclusions are in line with insights from previous research (Smarius & Van der Stappen, 2022). Building on these findings, future research might explore what information students need in later stages of the choice-making process (exploration in-depth and commitment).

Students indicate the need for additional support in the form of a conversation with their mentor about the shortlist. The tool provides overview and structure, but students indicate that they need in-person meetings to clarify choices and align them with their learning goals, supporting the blended approach. However, future research with students can unravel which content can only be discussed by an in-person meeting and which parts can be digitalised. For example, Virtual Reality (VR) might substitute some parts of face-to-face interaction by experiencing elective course settings beforehand. Compared to textual or oral information, a VR experience leads to increased immersion by creating the perception of physical

presence in a non-physical world (Tao, 2019; Mayer et al., 2022), which could encourage active exploration and reflection (Geriş & Kulaksız, 2025).

A clear limitation of this study lies in its simulated nature. Participants were not required to make real decisions with tangible consequences, which may have influenced their level of engagement, search behaviour, and use of filtering options. As such, the observed interaction behaviours and patterns do not fully reflect authentic decision-making behaviours. Moreover, the students were selected from a pool of active academy council members and are therefore probably not representative of the entire student population. Furthermore, while trace data provides valuable insights into user interactions with the tool, its interpretation remains complex. For instance, frequent clicking may indicate either active exploration or confusion. Future studies should therefore consider combining trace data analysis with methods such as think-aloud protocols, walkthroughs or interviews. Such methods may give more insight into students' considerations in the exploration-in-breadth phase.

6 Conclusion

This study investigated how students use a digital tool to explore elective courses, what motivates their selections, and what additional support they need to make well-informed choices. According to the Dual Cycle Model, exploration-in-breadth is a key phase in decision-making. The findings suggest that students engage in both broad scanning and focused selection, consistent with this model. Students could benefit from digital tools for initial exploration but express the need for personal guidance to make final decisions. This outcome supports a blended guidance approach to support students in their choice-making process for elective courses in flexible higher education.

From the results of the logged trace data as well as the subsequent survey, we can deduce that students differ in behaviour and do not proceed through the exploration-in-breadth phase in a straightforward manner: They alternate between general orientation and targeted selection, requiring tools that facilitate this behaviour. We identified three clusters of students that display different navigation behaviour: rapid explorers, deep evaluators and prolonged browsers. Many students

express the need for more information on both the courses and well-informed choice-making and for personal guidance from a coach or coordinator.

A blended guidance approach to support students in their choice-making process for elective courses in flexible higher education is promising. Mentors or teachers of elective courses can inform students about the content of the module in relation to the students' goals, what pedagogical approach is applied, and how the learning goals are tested. For scalable and rich support, immersive technologies and recommender systems can be implemented. Van Rossen et al. (2024) posit in their position paper that more research is needed to explore benefits and risks of recommender systems based on Artificial Intelligence in decision-making processes and the impact of these systems on students when selecting elective courses in flexible curricula.

The findings of this study offer valuable insights into students' decision-making behaviour for educational purposes and can contribute to the development of evidence-informed tools to support students' choice-making process for elective courses in flexible higher education. Despite growing interest in the current topic, little is still known about, for example, contextual factors and their influence on choice behaviour and whether a digital choice support tool actually leads to more satisfaction with the choice or to better performance.

7 Implications for practice and policy

Institutions that are flexibilising their curriculum should support students in choosing elective courses, and this study contributes to knowledge about how this can best be facilitated with technology. Training mentors to guide students effectively in making well-informed choices is also essential. The current study provided insights in one part of the choice-making process, namely exploration-in-breadth supported by a digital tool. An important outcome is that students appreciate the technological support and that they differ in their behaviour in the tool. Importantly, students indicate that interaction with their coach (or mentor) is essential for them to able to make an informed choice for an elective course that fits their professional interests and goals.

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Appendix A

Filters used in the tool.

Domain	Location	Societal issues	Level	Credits	Period	Type of cooperation
Economics Behaviour & society Healthcare Education Law Language & culture Technology Cross-sectoral	4 Dutch cities	Biobased economy Broad prosperity and new entrepreneurship Arts Healthcare & wellbeing Safe and resilient city	NQLF-5 NQLF-6 NQLF-7	15EC 30EC 45EC 60EC	1 2 3 4	Interdisciplinary Monodisciplinary Multidisciplinary Transdisciplinary

Appendix B

Survey questions and answer categories.

Q1	How many items were on your first shortlist (NQLF 5)	Answer 1 – 10
Q2	How many items were on your second shortlist (NQLF 6)	Answer 1-10
Q3	What were important reasons for you to choose the courses you shortlisted? Please rank.	8 ranking options
Q4	What other important reasons were for you to choose the courses you shortlisted? Please rank.	6 ranking options
Q5	What are the top 3 reasons why courses did not make it onto your shortlist?	Open answer field
Q6	Drawing up a shortlist of elective courses was a first step in the process of choosing courses. What information do you still need in the follow-up process to make a well-considered choice for one course for which you would like to register?	6 options, multiple answers possible.
Q7	If you indicated that you wanted more detailed information about the course, can you indicate what information you would like and why this information?	Open answer field
Q8	If you have indicated that you would like to have a conversation about the courses on your shortlist, who would you like to have a conversation with and what should this conversation be about? Can you also indicate why this person(s)?	Open answer field
Q9	What is your opinion about the usability of the tool when compiling your shortlist? What could be better?	Open answer field
Q10	Which search options in the tool are you still missing? Why that one in particular?	Open answer field
Q11	Which course are you following and which to which academy does this course belong?	Open answer field
Q12	Were there any courses on your shortlist that were offered outside your own program but within your own domain?	Open answer field
Q13	Were there any courses on your shortlist that were offered outside your own domain?	Open answer field
Q14	What else would you like to say about this optional task and the possibility of choosing courses during your training at XX? For example, do you have any advice?	Open answer field