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ORIGINAL ARTICLE

From Spreadsheet Workarounds to an Innovation Experiment: Co-Creating a Clinical Placement Planning Prototype in Nursing Education

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ABSTRACT

The reform of nursing education in Germany increased demands on clinical placement planning. Within a publicly funded research and development (R&D) project supported by a state health ministry in Germany, a software prototype was iteratively developed at a University of Applied Sciences with a model region. Prior studies and practice reports suggest that existing digital tools mainly support school administration and that placement organisation often relies on manual or spreadsheet-based workarounds. The resulting web-based platform enables comprehensive placement planning in one integrated solution. In an initial evaluation (n=12), planners and practice coordinators rated usability and functionality positively, highlighting reduced effort, increased transparency, and improved coordination across training networks. Participants perceived that improved transparency, and coordination could support better use of existing training capacity, subject to local constraints. The findings underscore the relevance of a dedicated placement-planning solution distinct from conventional school administration software.

Keywords: Nursing Education; Clinical Placement Planning; Software Prototype; Usability Evaluation; Requirements Engineering; Digital Health innovation; Blue Ocean Strategy.

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INTRODUCTION

The global healthcare system faces an unprecedented workforce crisis, with an estimated shortage of 5.8 million nurses worldwide as of 2023, projected to persist at 4.1 million by 2030 despite ongoing workforce expansion (World Health Organization [WHO], 2025). This shortage disproportionately affects low- and middle-income countries, but high-income nations also struggle with recruitment, retention, and capacity challenges exacerbated by aging populations, pandemic-related burnout, and migration dynamics (Adhikari, 2023; WHO, 2025). Critically, this workforce gap is not solely a matter of supply; it is fundamentally linked to the capacity and quality of nursing education systems to train, place, and retain the next generation of nurses (Agnello et al., 2025). Clinical placement planning – the coordination of practical training across hospitals, care facilities, and educational institutions – has emerged as a critical bottleneck limiting training throughput, particularly in countries undergoing educational reforms (Bamberg et al., 2023; Lauxen et al., 2022). Addressing inefficiencies in clinical placement planning is therefore not merely an administrative concern but a strategic lever to unlock nursing training capacity at scale and contribute to mitigating the global nursing shortage.

Germany exemplifies these dynamics. The training of nursing professionals was fundamentally restructured with the 2020 Nursing Professions Act (Pflegeberufegesetz, PflBG), which merged formerly separate pathways (elderly care, acute care, paediatric nursing) into a generalist program qualifying trainees across all care settings, including psychiatry (Pflegeberufegesetz [PflBG], 2017/2023). This reform mandates 2,500 hours of clinical placements per trainee, requiring close coordination among nursing schools, healthcare facilities, and trainees themselves (Lukuc, 2021). In practice, this results in significant organizational challenges:

- High administrative workload in coordinating placements across multiple institutions
- Numerous stakeholders with fluctuating placement capacities, complicating reliable long-term planning
- Widespread reliance on inadequate tools—Excel spreadsheets or generic school administration software—that lack the flexibility, transparency, and real-time coordination features necessary for clinical placement planning (Lauxen et al., 2022)

As part of a one-year research and development project, we developed a software prototype for clinical placement planning in cooperation with a model region in one German federal state. The web-based platform

maps the entire process of clinical placement planning, transparently displays available slots and utilization, provides automated suggestion and monitoring functions, and enables direct communication between schools and clinical institutions. Our aim was to develop an approach to improve planning processes. This leads to the research question: What evidence does an initial evaluation provide regarding the usability and benefits of the prototype in clinical placement planning for generalist nursing education?

To situate our prototype development and evaluation within a broader innovation logic, the following section outlines the theoretical lens guiding our work, linking design-oriented health innovation frameworks with requirements engineering.

THEORETICAL BACKGROUND

Clinical placement planning is a complex organizational task that requires intensive coordination and resources. The literature highlights the potential of digital solutions: they can automate planning processes, increase transparency, and improve coordination (Bamberg et al., 2023; Kümpel et al., 2022; Lauxen et al., 2022). At the same time, specialized, user-oriented systems that cover the entire process of clinical placement planning and incorporate the perspectives of all stakeholders are lacking (Lux & Matusiewicz, 2022). In health innovation and entrepreneurship terms, this represents process innovation and opportunity recognition at the interface of education and care, where value is created by reducing coordination frictions across stakeholders (Glover et al., 2024).

As a theoretical framework, Requirements Engineering (RE) offers methods for the structured elicitation, documentation, validation, and management of requirements to prevent mismatches between technology and its context of use (Gupta, 2023). In particular, RE supports the translation of heterogeneous stakeholder needs into consistent, verifiable specifications and thus provides a foundation for iterative prototype development and early assessments of utility (Gupta, 2023). Based on this framing, we operationalized RE through stakeholder workshops, user stories, and iterative prototyping to align needs, features, and evaluation criteria in a traceable manner.

METHODS AND DATA

Our project was conducted in cooperation with eight nursing schools that were part of a regional training consortium in one German federal state. Three stakeholder groups were involved: a state-level health authority, the regional consortium with schools and clinical institutions, and subject-matter experts at the respective sites. The clinical institutions represented in the consortium covered all relevant placement and specialty areas of generalist nursing education, thereby reflecting its complexity.

To capture and structure the requirements, an approach grounded in requirements engineering was chosen because it enables systematic elicitation, documentation, validation, and change management and supports traceability from stakeholder needs to implemented functions (Gupta, 2023; Dalpiaz & Brinkkemper, 2018). Diverging needs across institutions were consolidated into user stories and iteratively reviewed in multi-stakeholder workshops; where trade-offs emerged, prioritization decisions and rationales were documented in the project backlog to maintain transparency and traceability across stakeholders. We used requirements engineering as the backbone for systematic elicitation, prioritization, and traceability across institutions, and complemented it with user-centered co-creation and rapid prototyping to support the innovation-experiment character of the project (Kilfoy et al., 2024; Tsangaris et al., 2022).

For the evaluation, individuals responsible for planning at nursing schools as well as clinical placement coordinators were given access to the prototype. After a standardized introduction via training videos, they tested the application with provided test data over a period of 14 days. All functions could be used under realistic conditions. For the evaluation, a standardized online questionnaire was created and administered using evasys. It combined closed items on a five-point Likert scale with open-text fields. The closed questions captured seven dimensions: participant role, user-friendliness, functionality, specific functions for schools, potential for everyday work, automation potential, and overall impression of the test phase. Supplementary open-ended questions allowed qualitative feedback on strengths, weaknesses, and potential improvements. The combination of quantitative and qualitative data enabled a differentiated assessment of user experiences. Items were rated on a five-point Likert scale (1 = strongly agree/very good; 5 = strongly disagree/very poor). Missing responses were treated as missing values and descriptive statistics were calculated using pairwise deletion. Participation was voluntary and based on informed consent; responses were collected anonymously and no patient data were processed.

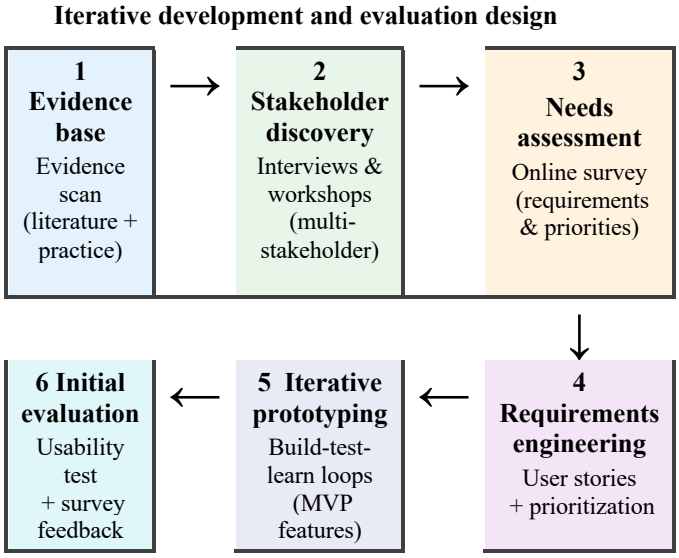

Fig. 1. Requirements-driven co-creation and rapid prototyping treated as an innovation experiment (iterative loops followed by initial usability evaluation).

RESULTS

Sample

Twelve participants took part in the evaluation; 50% were responsible for planning at nursing schools, and 50% were clinical placement coordinators in institutions.

Usability

Overall, usability was rated positively. The arrangement of functions received the highest rating (M = 1.5, SD = 0.8, n = 11), closely followed by navigation within the software (M = 1.6, SD = 0.5, n = 11). Performance was assessed as satisfactory (M = 1.8, SD = 0.9, n = 12). The clarity of the interface was rated positively, although with greater variance (M = 2.2, SD = 1.2, n = 12).

Innovative core functions

- **Monitor (capacity/utilization overview).** The monitor function provides a clear overview of the occupancy status of clinical placement slots and enables early identification of free capacities as well as peak utilization. This allows planners to better manage trainee placements and avoid overbooking. Especially in areas with limited resources, the function contributes to transparency and coordination. In the evaluation, participants rated the overview of available slots positively (M = 2.0) and emphasized its support for more efficient distribution (M = 1.9). In addition, the perceived planning reliability increased through the use of the monitor (M = 1.8).
- **Automatic distance calculation (residence/placement site).** This function automatically calculates the distance between a trainee's residence and potential clinical placement sites and presents the results in an overview. Planners can thus immediately identify which institutions are within accessible range. In addition, the distances are combined with further parameters such as utilization or available slots and displayed in a comparative view. This facilitates local placement assignments, avoids long commuting distances, and increases transparency in the selection of placement sites. Planners rated the function as a clear support for the planning process (M = 1.3, SD = 0.8, n = 6).
- **Communication module (requests/notifications).** The communication module consolidates all placement requests between schools and clinical institutions in a central overview. Open cases can be tracked and processed directly, thereby shortening feedback loops and simplifying coordination processes. Automatic email notifications additionally inform users about new requests or status changes, ensuring that no cases are overlooked. In the evaluation, participants largely rated the notification function as helpful (M = 1.7). The overview of sent and received requests was also described as practical support (M = 1.8). The layout of the request view and the quick overall overview of processing status were likewise positively evaluated ($M \approx 2.0$).

Overall assessment

Participants generally rated the prototype as a helpful tool for the entire planning process. Approximately two-thirds reported that they could imagine using it in their professional practice. A similarly high proportion saw clear potential for efficiency gains in the application and expected a lasting simplification of planning procedures. These assessments were also reflected in the mean values, which were M = 1.8 on the five-point scale for both intentions to use and expected efficiency gains. Survey responses suggest that participants were able to use the software after a short onboarding period. For the training, 16 short videos with a duration of 30 to 60 seconds each were provided. These conveyed the core functions of the prototype. The tutorials were viewed independently by the users. Afterwards, the vast majority reported being able to apply the software. In addition, the evaluation included an assessment of the potential for further partial automation. Already after the first test run, 81% of respondents indicated that they generally saw potential for the partial automation of the planning process.

Overall, respondents expressed majority satisfaction with their initial user experience (M = 1.9), although open comments pointed to improvement needs in clarity and level of detail. Specifically, respondents suggested displaying capacity as absolute slot numbers (not only percentages), making overbooking more visible, and refining request handling to prevent overwriting. Moreover, the results suggest that the increased transparency and improved coordination in the allocation process can help to make better use of existing training capacities. Participants emphasized that free slots can be identified more easily, and overbooking can be avoided. This underlines the potential of the software to increase the overall availability of training capacities. Additional tables and figures from the survey evaluation are available in the Supplementary Material.

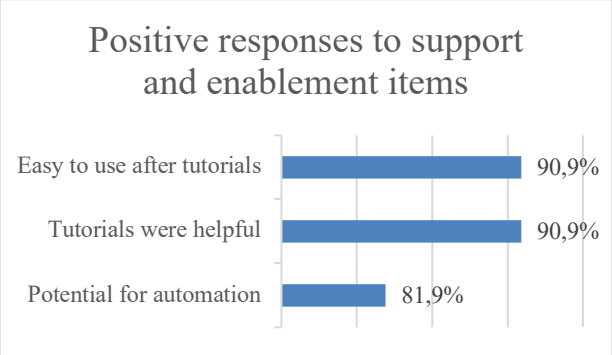

Fig. 2. Percentage of respondents who agreed or fully agreed (Top-2-Box) with selected support and enablement items from the evaluation (n varies by item).

DISCUSSION AND CONCLUSIONS

Overall, the development and evaluation results point out a clear differentiation potential compared to existing administrative software. Our concept addresses a niche in clinical placement planning that has so far remained unserved. While existing systems are primarily designed for administrative processes, the prototype opens a functional space that integrates the complex coordination between schools, clinical institutions, and trainees. In this way, it not only provides a technical tool but also establishes a new market area in which planning is understood and digitally supported as a strategic process.

Across the build–test–learn cycles, three learning points emerged: (1) transparency of placements and capacities is the primary pain point for planners across institutions; (2) mapping user stories to implementable features helps resolve competing needs and supports acceptance; and (3) small, testable MVP increments (e.g., capacity overview, rule-based conflict checks) reduce coordination effort and make benefits visible early.

From a nursing education practice perspective, the initiative can be interpreted as entrepreneurial action: a practical problem was identified, explored through iterative inquiry, and translated into an implementable prototype in collaboration with stakeholders. This aligns with Deweyan inquiry as a mode of problem-driven experimentation and with nursing innovation perspectives emphasizing agency and reflective practice (Stompff et al., 2022; Rigtering et al., 2023).

The requirements-driven co-creation approach is transferable to other multi-stakeholder planning contexts that face dynamic capacities and regulatory constraints (e.g., interprofessional placements, medical education rotations, continuing education scheduling, or workforce deployment planning). Key adaptation steps are stakeholder mapping, a shared vocabulary for constraints, and continuous traceability from needs to features and evaluation criteria (Kilfoy et al., 2024; Talwar et al., 2023; Mucha et al., 2024).

However, our study is subject to several limitations. The evaluation was conducted with a small sample within just one model region, which restricts the generalizability of the findings. In addition, the test phase was limited in time, preventing conclusions about long-term effects or sustainable implementation. The results are based on self-reports; objective performance indicators were not analysed. In addition, trainees were not included, although they are directly affected by placement allocations; their perspectives therefore remain outside the present evidence base.

Nevertheless, this leads to a “Blue Ocean” approach (Kim & Mauborgne, 2005): value creation arises not from competition within the existing market segment but from opening a new application field specifically for clinical placement planning. This value innovation combines efficiency gains for organizations with greater transparency and planning quality. At the same time, it creates a market for which no specific solution previously existed. This differentiation creates opportunities for venture development. Based on the development and evaluation results, the prototype could be commercialized as a scalable software-as-a-service (SaaS) offering, adopted by training consortia on a subscription basis (Benlian et al., 2009).

The development demonstrates that universities of applied sciences can act not only as neutral research actors but also as active contributors in the innovation and transfer process. By systematically further developing results from a model region, the foundation is created for a potential spin-off that is both scientifically grounded and practice-oriented.

Building on the present findings, the next step will be to advance the prototype in cooperation with additional model regions. The perspective of trainees will be systematically included to validate usefulness, usability, and acceptance under real planning scenarios. Their involvement is essential, as they represent by far the largest user group compared to the relatively few planners and placement coordinators. They are directly affected by placement assignments, experience their

consequences in everyday training, and can therefore provide critical insights into transparency, fairness, and practicality. This step also addresses the limitations of the first test phase (small sample, one region, short duration) and broadens the empirical basis. The overall aim is to transfer the prototype into a spin-off–ready business model (e.g., software-as-a-service) and iteratively secure the required product, market, and scaling aspects.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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