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Learning analytics to explore the motivational profiles of non-traditional practical nurse students: a mixed-methods approach

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Abstract

Learning analytics provides a novel means to examine various aspects of students' learning and to support them in their individual endeavors. The purpose of this study was to explore the potential of learning analytics to provide insights into non-traditional, vocational practical nurse students' (N = 132) motivational profiles for choosing their studies, using a mixed-methods approach. Non-traditional students were somewhat older learners than those following a more straightforward educational pathway and had diverse educational or professional backgrounds. Institutional admission data and analytics were used to identify their specific study motives and distinct motivational profiles, and to illustrate the connections between the motives emerging in the motivational profiles. Furthermore, the association between the motivational profiles and study performance was examined. The results of qualitative content analysis indicated that non-traditional practical nurse students pursued such specialized training for various reasons, and that pragmatic, professional rationales were emphasized over prosocial, altruistic factors. Through the adoption of person-centered latent class analysis, three motivational profiles were identified: self-aware goal-achievers, qualification attainers, and widely oriented humanitarians. Additionally, the analyses of epistemic networks for the profiles showed the complex interplay between the motives, confirming that some motive connections appear to be more prominent than others. Moreover, the findings indicated that study motives reported at admission did not seem to dictate students' later study performance, as no statistically significant associations were found between the motivational profile and the students' final grade point average or study dropout. This investigation paves the way for more-targeted motivational support and the use of learning analytics in the context of vocational education and training.

Keywords: Learning analytics, Study motives, Motivational profiles, Practical nurse students, Non-traditional students, Vocational education and training, Mixed-methods approach, Latent class analysis, Epistemic network analysis

Introduction

Vocational education and training (VET) plays a key role in meeting the competency demands of an emerging workforce. It also offers studies for those young people and adults seeking vocational qualification in the social and health care field and wanting to work as practical nurses (PNs).¹ In order to attract new students and retain existing ones, educators are challenged to better understand the motives that are driving PN students to choose this particular educational pathway. They are also invited to recognize similarly motivated student groups, described by a specific motivational profile, with the goal of providing these individuals with more-targeted support and promoting their development into healthcare professionals.

Since vocational studies appear to be gaining popularity, especially among mature learners (Markowitsch and Hefler 2019) with diverse educational and professional backgrounds, it has become important to explore the motivational drivers of such “non-traditional” students, as they are frequently regarded. Understanding their motives for seeking PN training enables better consideration of the diversity of students and their specific characteristics. Moreover, there is a need to investigate whether these students’ initial study motives are decisive for their later study performance, specifically in regard to study dropout, as it represents a common educational challenge for VET worldwide (OECD 2010; FNAE 2019).

Recently, the field of learning analytics (LA) has opened up some new—and interesting—opportunities for educators to expand their knowledge about students’ motivational drivers, and to use such information in improving pedagogy and consequent learning. For instance, there is a high volume of digitized data warehoused in the student information systems of educational institutions that could facilitate the analysis of students’ profiles and study records at scale (Fischer et al. 2020). Information on students’ activity and performance is also accumulated in the learning management systems that track students’ engagement in courses and enable a closer examination of their online behavior (Romero and Ventura 2020). LA is developed to use these data sources and to provide analyses, reports, and visualizations so that the needs of various institutional stakeholders—such as students, teachers, and managers—may be addressed (Larusson and White 2014).

In this study, a particular focus is placed upon exploring the potential of institutional LA—that is, the administrative data extracted from the student information system of an education provider (specifically, a vocational institution). The study uses a mixed-methods approach to explore what insights the institutional data offer into the study motives and motivational profiles of non-traditional PN students (N = 132) as they enter the training program. Moreover, the study illustrates how the study motives are connected to each other within the students’ motivational profiles and how these distinct motivational profiles are associated with students’ performance at the final stages of studies, namely grade point average (GPA) and study dropout. Addressing these issues by mixing both qualitative and quantitative approaches allows for the consideration of multiple perspectives and the generation of informative and useful findings (Johnson et al. 2007).

¹ Specific educational pathways of practical nurses or somewhat equivalent representatives seem to vary by country, but are commonly organized through VET (for comparison, see Braeseke et al. 2013).

Besides contributing to both research and practice by widening the understanding related to the study motives and motivational profiles of non-traditional PN students, this exploratory study also seeks to provide grounds for a more systematic implementation of LA in VET. Gedrimiene et al. (2020) noted that the potential of LA has neither been widely acknowledged in vocational settings nor adequately harnessed to facilitate the provision of motivational support to vocational students. Since many aspects of VET involve hands-on training without online traces, it is crucial to use other sources of student data (e.g., institutional data) to gain better knowledge of the students in VET (López-Pernas et al. 2023).

Conceptual framework

Motivational drivers of nursing students

Motivation is strongly connected to the acquisition of competences needed to successfully negotiate future endeavors (Salmela-Aro 2018). It refers to a set of processes that initiate and sustain goal-oriented activity (Schunk et al. 2014) by giving energy and direction to one's behavior (Ryan and Deci 2017). The ability to study and direct competence development in a motivated manner is also expected of PN students entering the field of social and health care. To perform successfully in their studies, PN students need to be aware of the motives that drive their actions and help them to strive toward their goals. It is also vitally important for many educators to understand what motivates students to study and work in nursing, as such information is thought to contribute to student retention (Jeffreys 2015; Price 2009), student recruitment (McLaughlin et al. 2010; Mooney et al. 2008), student support (Messineo et al. 2019), and the informed decision-making of potential learners (McLaughlin et al. 2010). Furthermore, it is seen to benefit the student selection process by allowing the identification of students who are most likely to successfully complete their studies (Sadler 2003).

When selecting their course of study, students are typically driven by various reasons, goals, desires, and strivings, referred to here as study motives (cf. Hirsto and Tirri 2009; Messineo et al. 2019; Ryan and Deci 2017). These motives tend to appear as co-occurring factors and emerge in multiple combinations (Côté and Levine 1997; Skatova and Ferguson 2014). Reasons for choosing studies or pursuing a career in nursing have been examined in several studies, resulting in various motive categorizations. These studies, conducted mostly among higher education nursing students, have shown that the most common motives are an altruistic desire to care for and help others and the chance to increase job security and career opportunities (Jirwe and Rudman 2012; Marcinowicz et al. 2016; McLaughlin et al. 2010; Messineo et al. 2019; Mooney et al. 2008; Wilkes et al. 2015). Nursing students are also driven by their professional calling, personal interests, experiences, and characteristics, as well as by the influence of significant others such as family members or friends (McLaughlin et al. 2010; Messineo et al. 2019; Wilkes et al. 2015). In addition, some students emphasize the practical reasons behind their decision-making, such as a chance to participate in training arranged close to home (Jirwe and Rudman 2012), while others consider nursing studies only a secondary choice, perhaps having failed to gain admittance to some other educational program (Jirwe and Rudman 2012; Marcinowicz et al. 2016; Messineo et al. 2019). For many, nursing appears to be a rewarding profession with a positive image (Messineo et al. 2019; Mooney et al. 2008),

although a lack of respect has also been observed (Marcinowicz et al. 2016). In a general sense, the field is thought to provide the opportunity to work with people (Wilkes et al. 2015) and to advance knowledge and skills (McLaughlin et al. 2010).

Recently, attempts have been made to deepen the knowledge related to nursing students' study motives by identifying the groups of students who share certain motivational combinations and thus a similar type of motivational profile. Vansteenkiste et al. (2009) and Wijnia and Baars (2021) noted that all motives are not equally important to all students, and some are more dominant than others in driving a learner's behavior. Person-centered approaches have shown that nursing students differ in their motivational profiles, for instance, in terms of quality and quantity of their study motives (Messineo et al. 2019).

Studies conducted in various contexts have also shown that certain types of motivational profiles seem to associate with optimal learning outcomes when drawn upon one or more theoretical frameworks at different stages and levels of education (e.g., Gillet et al. 2017; Linnenbrink-Garcia et al. 2018; Steinmayr et al. 2019; Vansteenkiste et al. 2009). Further, some have indicated that even the initial motives for entering studies play a role in study satisfaction over time (Janke 2020), study dropout (Nesje and Wiers-Jensen 2023), and contemplating study dropout (Janke 2020). The rationales behind these relations are inherently complex and tied to specific theoretical models and perspectives, through which they have been examined and analyzed. For instance, it has been argued that certain types of initial study motives may shape students' ways of adapting to a new learning environment, while evoking favorable or unfavorable conditions for subsequent learning (Janke 2020). Given the interesting nature of such findings, further work is required to determine whether similar connections can be found in other educational settings, and for study motives that are not of a specific type with certain theoretical groundings—that is, the more general reasons for pursuing a nursing education.

Emphasis on non-traditional learners

While previous studies have primarily focused on nursing students in higher education, little is known about the motivational drivers and characteristics of PN students who conduct their studies in the context of VET. Thus, there is a need to shed light on the specific study motives and motivational profiles of PN students, whose educational pathways and vocations are somewhat different from those of higher education nursing students. In particular, more attention must be paid to non-traditional learners, as their numbers seem to be rising across educational settings (see e.g., Adams and Corbett 2010; Brunner and Ehlers 2021; Markle 2015; Markowitsch and Hefler 2019).

Non-traditional students are defined in a variety of ways (Wild et al. 2023), and commonly in the context of higher education (Chung et al. 2014). For instance, they have been identified as learners who are somewhat older than the average student, who have diverse educational backgrounds and possible gaps between educational transitions, and who often access their studies through indirect routes, in contrast to those students proceeding along a more traditional, straightforward pathway (Dunkel et al. 2009). This broad definition is also used in the present study to examine students who represent one or more of the aforementioned characteristics when applying for PN training.

Non-traditional students are generally considered a heterogeneous group of learners (Landrum et al. 2000) with varying motives for pursuing a course of study—for instance, professional advancement, cognitive interest, or educational preparation (Francois 2014). According to Compton and colleagues (2006), non-traditional students are often adults in transition, and they tend to pursue studies that result in a vocational certificate or degree. Many non-traditional students have additional commitments outside of education that may also contribute to their decision to apply for studies (Adams and Corbett 2010). For instance, Dos Santos (2020) has reported that non-traditional nursing students' motives for pursuing education are based primarily on family considerations such as better financial resources and work schedule arrangements, and presenting a positive image to family members, including children. Also, the students seem to be driven by a chance to achieve a higher social status by setting a long-term career development pathway (Dos Santos 2020).

It has been argued that non-traditional students tend to face many types of challenges and concerns in their educational pathways and would therefore benefit from support specifically targeted to their needs (Moore et al. 2020). Getting to know these learners by identifying their motivational profiles and their links to subsequent performance is one way to address such a demand. There is also a need to better understand how the study motives interact and interrelate with each other, thus forming a complex, dynamic whole that drives diverse students' actions (Hilpert and Marchand 2018). In response to these issues, the current study makes use of ambient data and emerging technologies available in educational settings, also referred to as learning analytics (LA). While providing new insights into the development of motivational support for non-traditional PN students, it also offers valuable information about using LA in the context of VET.

Using learning analytics to examine students' motivational drivers

Learning analytics (LA) has been the subject of growing interest in the field of education, as it provides a novel means for understanding teaching and learning processes as well as for improving educational effectiveness (Fischer et al. 2020). This potential is also captured in the common definition of LA as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs” (Conole et al. 2011, para. 4). LA is seen as a promising way to contribute to the development of competences needed in the working life milieu of the future (Kleimola and Leppisaari 2022) and to enable new insights into the various aspects of learning, such as motivation.

LA has been used as a tool to influence students' motivational processes—for instance, by analyzing and visualizing the students' performance and progress, and by providing them with related feedback (e.g., Karaoğlan Yilmaz and Yilmaz 2021). Furthermore, LA has been applied to examine the motivational characteristics and profiles of students and to explore their connections to student achievement through surveys and trace data obtained via learning platforms (e.g., Hong et al. 2020; Najafi et al. 2018; Saqr et al. 2023). However, in many of these initiatives, the focus seems to be on micro-level LA applications (Buckingham Shum 2012), which typically operate at the course level and are geared toward individual support. There seems to be a call for more research that harnesses the potential of institutional LA—that is, the use of longitudinal, meso-level data

and analytics to provide an institution-wide understanding of the motivational factors that explain and drive students' actions. As Lonn et al. (2015) argued, student motivation has not yet been widely considered when exploiting LA in an institutional context.

New avenues for using learning analytics

To create increasingly comprehensive profiles of their students, educators are seen to benefit from institutional LA that mine the trove of data obtained from educational processes, such as admissions (Jones 2019). Data extracted from admission applications have been commonly used, for instance, to predict dropout (López-Pernas et al. 2023) and study performance (Watrous et al. 2022). It has been argued that the information students report about themselves during the admissions process is not trivial, but instead sensitive and revealing (Jones 2019). This also applies to the study motives that students are increasingly asked to outline as part of the process, for instance, in the form of essays (Sadler 2003) and statements on motivation (Wouters et al. 2014). Instead of using this information only as part of the student selection criteria, further analyzing and visualizing it through the lens of LA may help educators to obtain better knowledge of their students and their needs for support, and ultimately to inform strategies aiming to improve educational effectiveness.

Although this type of qualitative, self-reported data may not lend itself well to computational analyses with a strong quantitative focus, it allows for complementary insights when revisited and supported by analytical tools specifically tuned to, and suited for, such data (Sherin et al. 2018). Applying both traditional qualitative methods and more novel LA techniques to a similar body of data, even to a smaller set, may enhance the interpretation of the results and foster the development of these supplementary approaches (Sherin et al. 2018). This type of research is not yet a common trend in the field of LA, but it has started to attract a growing interest among researchers (Ochoa and Merceron 2018; Song et al. 2022) and thus warrants further exploration.

While leveraging such educational data—collected unobtrusively upon admission and used for motivational insights—offers many promises, it also comes with challenges. In particular, the question arises as to what extent such data are shaped by the context in which they are collected and by the purpose for which they are intended. For instance, it has been argued that some motives may be emphasized over others, while some may remain underreported in a high-stakes situation such as admissions (Wouters et al. 2014). Additionally, such written personal information may prove difficult to assess due to the heterogeneity of responses (Wouters et al. 2014). Utilizing analytics in a valid way therefore requires an awareness of these contextual factors and the limitations they set for making analyses and drawing conclusions from such educational data (Ferguson et al. 2019).

Research has also highlighted the importance of theoretical underpinnings to laying the foundation for more meaningful interpretations from LA (Dawson 2015; Gašević et al. 2017; Wise and Shaffer 2015). Theories are needed to translate the results from LA into insights about learning (Wong et al. 2019) and to promote an understanding of what kind of data are needed, what kind of analytical methods must be applied, and what kind of users the results should be reported to (Banihashem et al. 2019). However, it seems that LA, which draws on educational sciences or well-researched theories of motivation,

is still at an early stage (Maag et al. 2022; Marzouk et al. 2016). Thus, more investment in its development is needed, as the absence of adequate theories in using LA can lead to misconceptions and a failure to uncover nuanced findings (Wise and Shaffer 2015). Additionally, more effort must be put into preparing education providers and their users to employ analytics and to make sense of it (Rienties et al. 2018), as digitally generated and visualized data representations are not necessarily always easy to interpret (Chatti et al. 2012). In striving to integrate analytics into their educational practices, educational institutions must consider their technological readiness, leadership, and strategy, and support their organizational culture as well as staff and institutional capacity, in order to better prepare for the many challenges it brings (Colvin et al. 2017).

Research questions

This study aims to explore the potential of institutional LA to provide insights into non-traditional practical nurse (PN) students' motivational profiles for choosing their studies. Specifically, four research questions (RQs) are posed:

- RQ1: What kind of study motives of non-traditional PN students can be identified through institutional data?
- RQ2: What kind of motivational profiles of non-traditional PN students can be discovered?
- RQ3: How are the study motives interrelated within the motivational profiles of non-traditional PN students?
- RQ4: How are the motivational profiles associated with non-traditional PN students' study performance (grade point average [GPA] and study dropout)?

Methods

Context

This study was conducted in the context of practical nurse (PN) training, organized as a part of upper secondary VET in Finland. Finnish PN training generally targets both young people and adults who are interested in developing their competences and options to work in the field of social and health care. In most cases, individuals may apply for training through either the joint application or rolling admission process. Joint applications are mainly aimed at young people (typically around 15 to 16 years old) who have completed comprehensive education or the equivalent and thus represent a more traditional group of students. Rolling admissions are intended for non-traditional students, such as those who have a previous vocational qualification or a higher education degree, are not admitted to training through the joint application procedure, or aim to complete a previously started training program. While, in recent years, the number of traditional PN students who begin their studies by way of joint application has generally decreased, the number of non-traditional PN students coming through the rolling admission process has increased, with these applicants currently representing the majority of PN students (see Vipunen 2023a, b).²

² Although the annual amount of rolling admission applicants is not directly shown in the statistics, it can be estimated by subtracting the annual number of students who were admitted through the joint application (see Vipunen 2023a) from the annual number of *all* students who started a course toward vocational qualification in social and health care (see Vipunen 2023b).

The duration of Finnish PN training varies according to individual factors such as previous education and work experience. However, it usually lasts two to three years. The studies consist of vocational units and common units, which are defined for each student in more detail in their personal competence development plan. Students demonstrate the required competences by performing practical tasks and processes in authentic situations where they are assessed by both teachers and representatives of working life. Numerically evaluated studies use the scale of excellent (5), good (3–4), satisfactory (2–1), and fail (0). Successful completion of PN training allows the student to obtain a vocational qualification in social and health care, the scope of which is a total of 180 competence points (ECVET points³). The vocational qualification in social and health care is a prerequisite for acting as a practical nurse in Finland, where PNs may work in various areas of nursing and care in the public, private, and third sector—for example, in hospitals, health care centers, nursing and residential homes, home care, and rehabilitation institutes. Although there are no specific statistical data available on the drop-out rate among PN students, the increasing number of students dropping out from their studies has been a common concern facing Finnish VET (OSF 2022).

Participants and procedures

Study participants ($N = 132$) were students in the PN training programs organized by a large-sized vocational education provider in Finland. All participants had applied for PN studies through a rolling admission procedure and were considered non-traditional students. The participants had diverse educational and professional backgrounds. Most of them (102, 77.3%) had completed a previous qualification or degree other than comprehensive education, and the vast majority (104, 78.8%) were already included in the labor force, either as employed, unemployed, or entrepreneurs. Additionally, the participants were somewhat older than the 15- or 16-year-old traditional students applying for studies directly from comprehensive education through the joint application procedure. Their age ranged between 17 and 68 years ($M_{age} = 42.37$, $SD_{age} = 13.96$); 69 (52.3%) were male, and 63 (47.7%) were female. The majority of the participants (115, 87.1%) reported Finnish as their native language. The students had started their training in August 2018 at the earliest, and had completed or dropped out until March 2022.

The admission procedure was conducted via an online application form in which the students were requested to answer open-ended questions or to provide arguments about their study motives and other related aspects. The aim of these questions and arguments was to bring up the various reasons, needs, and intentions for studying and working in the field and choosing the training program as a basis for student selection. These data were used in the study.

Students who had not reported on their study motives but had only provided other information in the application were excluded from the study. Students who had applied for PN training through a joint, national application procedure were also excluded, as they were not requested to report on their study motives at admission and were not

³ According to the recommendation of the European Parliament, Council of the European Union (2009, 14), an ECVET point refers to “a numerical representation of the overall weight of learning outcomes in a qualification and of the relative weight of units in relation to the qualification.”

included in the target group of this study. Moreover, applicants who had not been admitted to the training program and students who were still studying were similarly excluded, as there was not enough information available on their study performance.

The application data for all of the study participants were extracted from the education provider's student information system for the purposes of this study. The data consisted of socio-demographic information (gender, birthdate, employment status, educational attainment, and native language) and information on the training program for which the students had applied. Furthermore, it included the information about the students' study motives accumulated in the applications' open-ended responses. The application data were further supplemented with information on the students' completion status of training (completed/dropped out) and grade point average (GPA). All data were anonymized. National ethical principles of research with human participants (Kohonen et al. 2019), EU GDPR (2016/679), and the National Data Protection Act (1050/2018) were strictly followed in the study. The research design was approved by the University of Eastern Finland Institutional Review Board (decision 11/2020).

Data analysis

The study used a mixed-methods approach (Creswell and Plano Clark 2018; Johnson et al. 2007; Tashakkori and Teddlie 2010) by exploiting more traditional research methods, both qualitative and quantitative, with novel LA techniques in the analysis of institutional data. The purpose was to promote an understanding of the research phenomenon (Creswell and Plano Clark 2018; Johnson et al. 2007) by addressing each research question with a suitable analysis method. The study capitalized on the strengths of each method, as also suggested by Onwuegbuzie and Teddlie (2003) as well as Creswell and Plano Clark (2018). The analyses were conducted in a sequenced, connected manner (Plano Clark and Ivankova 2016)—that is, the findings from the former method(s) were needed to produce, explain, and understand the results of the latter.

The process began with a qualitative approach, which not only allowed for a focus on the authentic voices of the students and their specific study motives, but the results of which also contributed to the illustration and interpretation of findings of the subsequent quantitative phase and its analyses. Transforming the qualitative data into quantitative form (Tashakkori and Teddlie 1998) was additionally performed to gain an improved knowledge of students' motivational profiles using novel LA techniques. Moreover, it was conducted to build on their findings with quantitative data and statistical analyses in order to discover the connections between the motivational profiles and study performance. To obtain complementary insights (Greene et al. 1989), both qualitative and quantitative approaches were needed to address the research aim. The analytical steps that were followed to answer the research questions are summarized in Fig. 1 and explained in more detail below.

RQ 1: Identifying study motives through qualitative content analysis (QCA)

To answer RQ1, the institutional data was first examined with qualitative content analysis (QCA), which aims to capture the meaning of qualitative data in a systematic and flexible way (Schreier 2012). The unit of analysis was a student's application, and the purpose was to identify parts of the data that would demonstrate a distinctive study motive

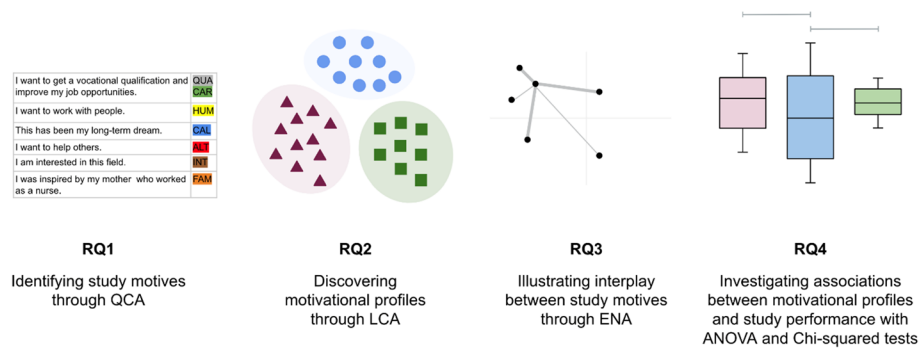


Fig. 1 Data analysis methods

in the form of words, phrases, sentences, or passages. In line with the principles of QCA (Elo and Kyngäs 2008; Mayring 2022; Schreier 2012), the material was manually coded using an inductive, data-driven approach—that is, the codes were derived from the data itself, and similar instances were labelled with the same code. The initial analysis produced sets of preliminary codes that were then developed into eight categories based on the links found between them. A brief description and some phrases extracted from the students' responses were added to each category to highlight its meaning. Using this preliminary motive categorization as a coding scheme, a portion (25%) of the student applications were independently coded by two researchers (first and third authors of this study). The results of this parallel analysis were compared between the researchers and also thoroughly discussed in the research group (the authors of the study). A few disagreements were negotiated until a consensus was reached. Additionally, some minor, collectively agreed-to changes to the coding scheme were made, resulting in a total of nine final motive categories—that is, distinct study motives. Thus, the data were once again screened using these refined codes. The frequency of the study motives in the data and their prevalence for each student were calculated. However, multiple references related to the same motive category in a student's answer were counted only once. Each motive was coded as 1 if it was present in the student's application or otherwise as 0 to enable subsequent quantitative analysis.

RQ2: Discovering motivational profiles through latent class analysis (LCA)

To answer RQ2, the study took advantage of latent class analysis (LCA) (Goodman 1974; McCutcheon 1987). The aim was to identify distinct subgroups of students whose study motives were similarly combined, thus forming a certain motivational profile. LCA is a person-centered approach that discovers existing, yet unobserved, subgroups of individuals that are homogenous, close to one another, and different from other subgroups (Hickendorff et al. 2018). It is used to capture individual differences and to address the heterogeneity within a given sample (Hickendorff et al. 2018; Scotto Rosato and Baer 2012). The probability of each individual belonging to a particular subgroup is determined based on maximum likelihood estimation (Goodman 1974; McCutcheon 1987). In this study, the distinct motive categories that occurred within each student were used as input data for the clustering, which was performed using the R! *poLCA* package (version 1.6.0.1; Linzer and Lewis 2011). Ten models were estimated with one to ten clusters.

The best number of clusters was chosen based on the lowest Akaike information criterion (AIC) (McCutcheon 1987), which pointed to three clusters as the optimal solution.

RQ3: Illustrating interplay between study motives using epistemic network analysis (ENA)

To answer RQ3, the study applied the method of epistemic network analysis (ENA; Bowman et al. 2021; Elmoazen et al. 2022; Shaffer 2012). The purpose was to illustrate the complex interplay of study motives within the motivational profiles, following the methods of Kahila et al. (2023) and Scrucca et al. (2023). ENA uses a collection of methods and network visualization techniques to identify connections among constructs, illustrating them in network models that can be compared visually and with summary statistics showing the weighted structure of connections (Shaffer et al. 2016). In this study, the rENA package for the statistical programming language R (version 0.2.4; Marquart et al. 2022) was used. Each network model was normalized, and a dimensionality reduction was applied (for a more detailed explanation of the mathematics, see Bowman et al. 2021; Shaffer et al. 2016). As is typical to ENA (Csanadi et al. 2018), the resulting epistemic networks for the motivational profiles were visualized using graphs, where nodes represent the codes (that is, categorized study motives), and the edges show the relative magnitude of frequency of co-occurrence between two nodes. The nodes' positions were fixed in the networks (Csanadi et al. 2018) to allow comparison among the motivational profiles. The position was calculated using an optimization algorithm, which “minimizes the difference, for any given network, between the point that represents that given network and the *centroid* or center of mass of the same network, computed from the weights of the connections in the network” (Csanadi et al. 2018, p. 427). The model had co-registration correlations of 0.91 (Pearson) and 0.93 (Spearman) for the first dimension, and co-registration correlations of 0.93 (Pearson) and 0.94 (Spearman) for the second. These measures indicated that there was a strong goodness of fit between the visualization and the original model.

RQ4: Investigating associations between motivational profiles and study performance with ANOVA and Chi-squared tests

To answer RQ4, statistical tests were applied to examine the relationship between the motivational profiles and study performance. A Welch One-way Analysis of Variance (ANOVA) was used to assess the association between the motivational profile and the students' general point average (GPA), for those who completed the qualification. The purpose was to examine whether certain motivational profiles were associated with higher or lower grades. Additionally, a Chi-squared test was performed to compare whether the proportion of students who had dropped out was the same for all motivational profiles.

Results

RQ1: What kind of study motives of non-traditional PN students can be identified through institutional data?

Qualitative content analysis (QCA) identified nine distinct study motives of non-traditional PN students that emerged from the institutional data. These motives are summarized in the order of frequency below and described in more detail in Table 1.

The most common study motive found among the majority of non-traditional practical nurse (PN) students (94, 71.2%) was a desire to obtain a vocational *qualification* (QUA). The training was considered as offering the students an educational pathway, a place to start or continue their studies, but also a means to obtain formal qualification and to meet the competence regulation requirements of working life. The next most common motive was related to desired work characteristics and increased *career* opportunities (CAR), which were described by more than half of the students (72, 54.6%). Studying in the field was thought to enable employment, job security, and career versatility, and to enable professional reorientation and change of working field. *Personal* factors (PER) were also frequently mentioned by many students (71, 53.8%), who reported having suitable personal abilities, characteristics, experiences, and circumstances for operating in the field. Some of the students (53, 40.2%), in turn, were driven by a *human orientation* (HUM), a desire to work closely with people and specific target groups, while others (52, 39.4%) valued the possibility for *competence* development, education, and learning (COM). A genuine *interest* (INT) was a reason to commence studies for over a third of the students (52, 39.4%), as they indicated a personal attraction toward the field and to topics related to it. A smaller portion of students (35, 26.5%) indicated *altruistic* desires (ALT), such as helping and caring for people or considering the interests of others. One of the least frequently mentioned motives was the possibility to follow one's *calling* or long-term dream (CAL), as it was a motivational factor only for some students (25, 18.9%). The *family* influence (FAM) was highlighted even less, as it was mentioned by only a few students (6, 4.6%). Those with this motive reported being inspired and encouraged by family members and those close to them who were in the social and health care field. The study motives appeared in the students' answers in various formations and combinations, and an average of 3.48 distinct study motives were found for each student ($Mdn = 3.5$, $Mo = 4$, $SD = 1.73$).

RQ2: What kind of motivational profiles of non-traditional PN students can be discovered?

The person-centered method of latent class analysis (LCA) revealed three distinct clusters, that is, subgroups of non-traditional PN students whose study motives were similarly combined in their motivational profiles. The prevalence of study motives within the motivational profiles of students is presented in Fig. 2.

The first subgroup (see Fig. 2, left), named as "self-aware goal-achievers," included 34 students (25.8% of all students), *all* of whom were driven by person-related factors (PER), such as appropriate personality and abilities needed in the field, and a desire to obtain a vocational qualification (QUA). Besides being aware of the personal factors suitable for the field, the subgroup seemed to be very goal oriented, as the career and work motive (CAR) was prevalent with 25 students (73.5% of the students in the subgroup), and the competence development motive (COM) was found in 21 (61.8%) students. Interest motive (INT), in turn, occurred with 13 (38.2%) students. However, the rest of the motives were much less accounted for in this subgroup. Altruistic desires (ALT), such as helping and caring for people, were expressed by five (14.7%) students, willingness to work in a human oriented field (HUM) was described by four (11.8%) students, and a calling (CAL) was experienced only by one (2.9%) student in this subgroup. The family influence motive (FAM) was completely missing from this subgroup.

Table 1 The categorization of non-traditional practical nurse students' study motives

Motive category	ABB. code	Prevalence	Brief description	Data examples (translated from Finnish to English)
Vocational qualification	QUA	71.2% (N = 94)	Obtaining a vocational qualification Completing a previously started vocational qualification Meeting qualification requirements Vocational retraining	<i>I would finally get myself a vocational title</i> <i>I am already in training in the field and want to continue to complete the qualification</i> <i>Considering current staff requirements, I need qualification to work in family homes' staff strength</i>
Career and work	CAR	54.6% (N = 72)	Employment Increased work opportunities, job security Career in the field, career versatility Characteristics of work Professional reorientation, change of working field	<i>I aim for a wide and diverse career in the field of care</i> <i>I am motivated by the number of jobs after graduation and the opportunity to work in the field without interruption</i>
Personal factors	PER	53.8% (N = 71)	Personal characteristics, abilities, preferences, and life circumstances suitable for studying and working in the field Personal experiences Health issues	<i>I am social, gentle, and conscientious by nature—my urge to care is at a high level</i> <i>I am already a professional in the field with personal experiences</i> <i>For health reasons, I cannot continue in my previous job or in positions that correspond to my education</i>
Human orientation	HUM	40.2% (N = 53)	Working with people and specific target groups	<i>I want to work in a human oriented field</i> <i>I would like to work with the elderly and/or disabled, either at home or in care homes</i>
Competence development	COM	39.4% (N = 52)	Competence development Studying and learning Further education Personal development	<i>I want to develop into an expert in the field</i> <i>Studying and learning new things motivates me when applying to this field</i> <i>Through this, I could also continue to higher education if I want</i>
Interest	INT	39.4% (N = 52)	Personal interest Interesting work Interesting topics	<i>I am really interested in this field</i> <i>Work in the area of substance abuse and mental health in the area is of great interest</i>
Altruism	ALT	26.5% (N = 35)	Helping and caring for others Influencing people's well-being Considering the interest of others	<i>What motivates me is that I get to help people and be really present</i> <i>The well-being of the elderly concerns me and I would like to be able to influence their well-being, for my part</i>

Table 1 (continued)

Motive category	ABB. code	Prevalence	Brief description	Data examples (translated from Finnish to English)
Calling	CAL	18.9% (N = 25)	Professional calling A long-term dream Meaningfulness and correspondence of work to one's personal values Possibility for self-actualization	<i>I feel that after graduation I could get employed to my dream job</i> <i>I get to do a job that has purpose and great significance</i> <i>A calling to the field motivates me to study and through the information from qualification I get to actualize myself by working in the field</i>
Family influence	FAM	4.6% (N = 6)	Family influence and support Family tradition Admiration for close ones in the field	<i>My husband works in the field of social and health sector. From him, I've gotten more and more desire to go into this field</i> <i>Since I was a child, I have admired my mother who is already a retired nurse. Through her, and especially after the birth of his own child, the idea of entering the field of care became stronger</i>

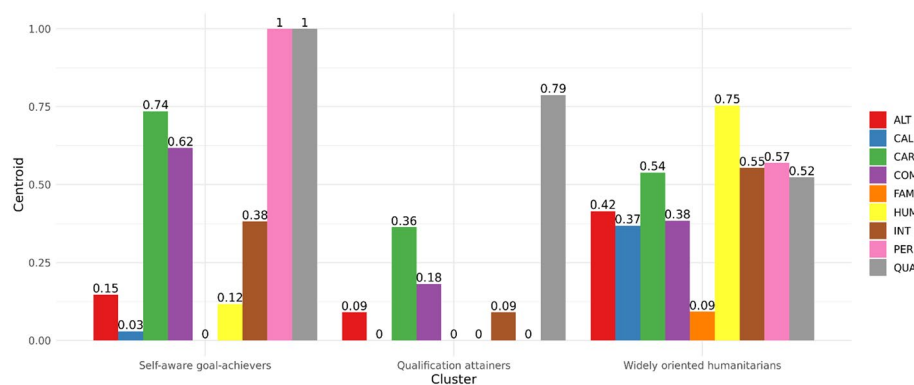


Fig. 2 The prevalence of study motives in non-traditional PN student motivational profiles. *ALT* altruism, *CAL* calling, *CAR* career and work, *COM* competence development, *FAM* family influence, *HUM* human orientation, *INT* interest, *PER* personal factors, *QUA* vocational qualification

The second subgroup (see Fig. 2, middle) with 33 students (25% of all students) was labelled as “qualification attainers,” as 26 (78.8%) students indicated a desire to acquire a vocational qualification (QUA) through training. With a much lower frequency, the second most frequent motive in this subgroup was the career and work motive (CAR) (12, 36.4% of the students in the subgroup), followed by the competence development motive (COM) (6, 18.2%). The altruistic motive (ALT) and interest motive (INT) accounted for only 3 (9.1%) students each. Despite some similarities in the overall occurrence of study motives with the other subgroups, this subgroup placed *no* emphasis on person-related factors (PER), willingness to work with people (HUM), or following one’s calling (CAL), which are the main differences compared

to other subgroups. Moreover, the family influence motive (FAM) had no presence in this subgroup.

The third subgroup (see Fig. 2, right), referred to as “widely oriented humanitarians,” was the largest, with 65 students (49.2% of all students), and the most diverse, with all of the motives represented. Of special relevance was the presence of the human orientation motive (HUM), as 49 students (75.4% of the students in this subgroup) preferred working close to people. There was also a rather strong prevalence of motives related to person-related factors (PER), interest (INT), career and work (CAR), and vocational qualification (QUA), as over half of the students in this subgroup expressed these motives (ranging between 34 and 37 of students, 52–57%). Somewhat less frequently mentioned motives in this subgroup were altruism (ALT), competence development (COM), and calling (CAL) (ranging between 24 and 27 students, 37–42%), while being more common compared to the other subgroups. Family influence (FAM) was regarded as a study motive only by six students (9.2%) in this subgroup.

RQ3: How are the study motives interrelated within the motivational profiles of non-traditional PN students?

As the study motives occurred in multiple combinations within the motivational profiles, they were also expected to show interrelatedness. The epistemic network analysis (ENA) was used to examine the complex interplay of study motives and to illustrate the connections between them. The epistemic networks of the motivational profiles are shown in Figs. 3, 4 and 5.

The epistemic network of self-aware goal-achievers (Fig. 3) pointed out the expected connection between personal factors (PER) and vocational qualification (QUA), as *all* of the members of this subgroup addressed these two motives. Furthermore, both of these motives (PER and QUA) were strongly connected to career and work motive (CAR), and slightly less so to the motives emphasizing competence development

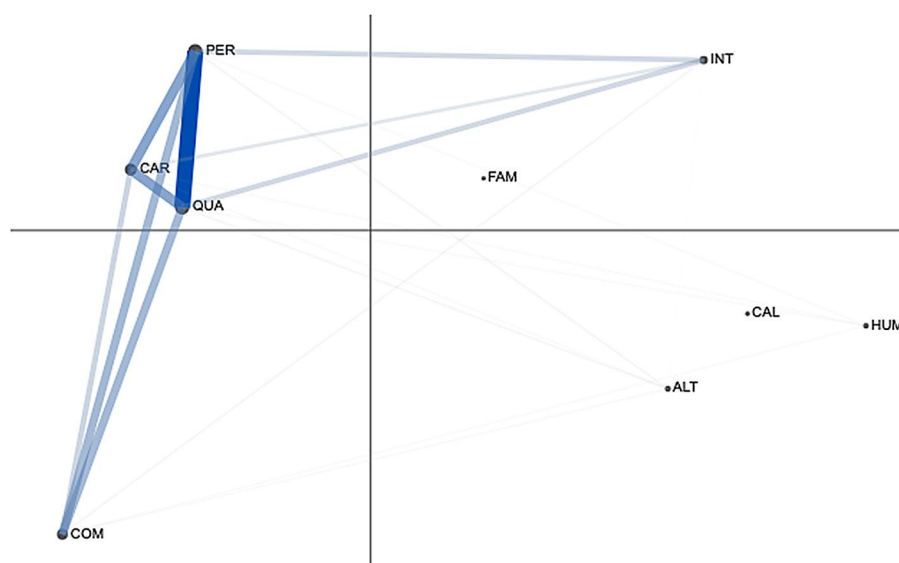


Fig. 3 Epistemic network for self-aware goal-achievers

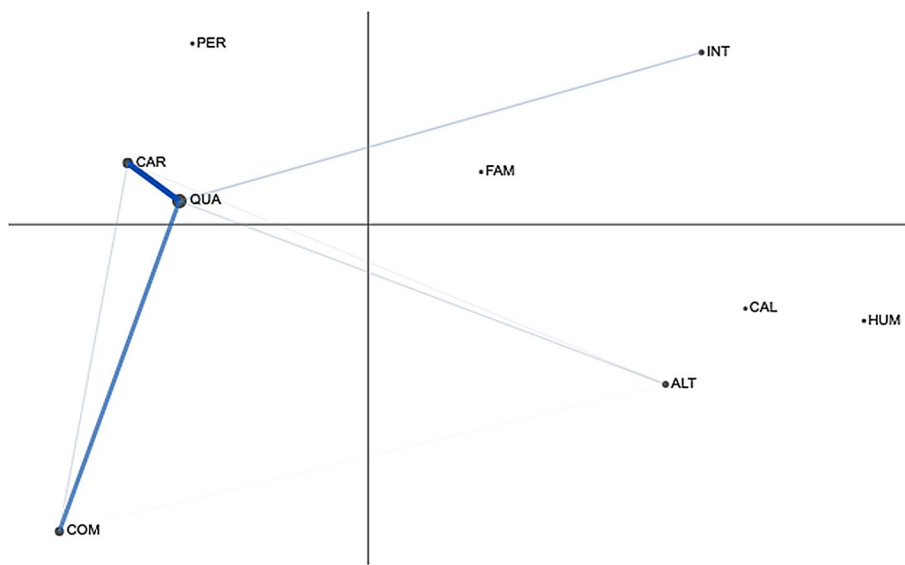


Fig. 4 Epistemic network for qualification attainers

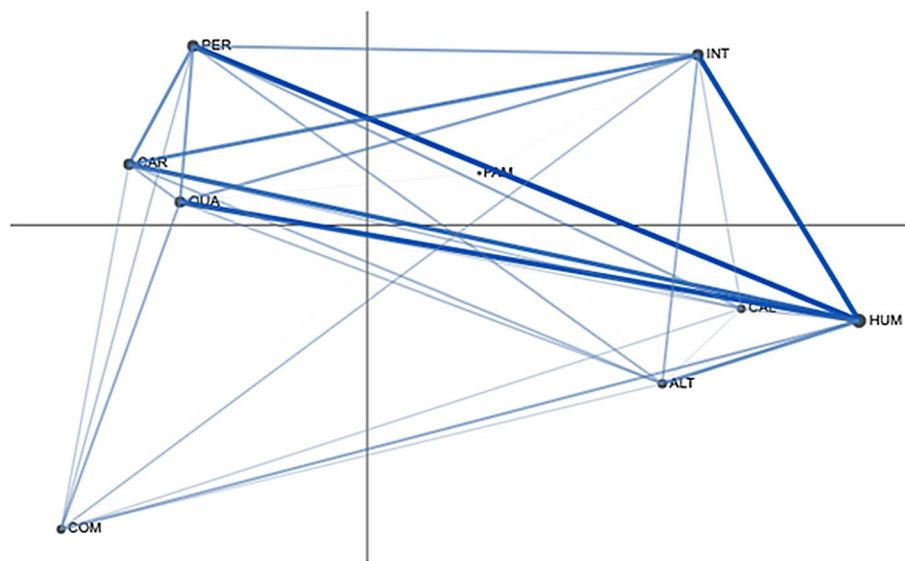


Fig. 5 Epistemic network for widely oriented humanitarians

(COM) and interest (INT). Career and work motive (CAR) was also moderately connected with the interest motive (INT). The less prevalent motives, such as altruism (ALT) and human orientation (HUM), seemed to occur together with the most prevalent ones. However, they showed no interrelatedness to each other, that is, none of the students presented two of those motives together. Calling (CAL) and family influence (FAM) appeared to be motives that had very few or no connections with the other motives occurring in this epistemic network. There was no single student that had only one study motive, but rather the motives appeared in pairs (2 students, 5.9%), groups of three (8, 23.5%), or larger groups (24, 70.6%) within the same student response.

The epistemic network of qualification attainers (Fig. 4) presented a different picture, where the strongest connection was between the vocational qualification motive (QUA) and the career and work motive (CAR). There was also an evident connection between vocational qualification motive (QUA) and competence development motive (COM). The vocational qualification motive (QUA) appeared to be the central one, as it was connected, to a greater or lesser extent, to all of the motives in the network. The rest of the interrelated motives had weak connections to each other, except for the interest motive (INT), which was only connected to the vocational qualification motive (QUA): two students showed these two motives, while one showed solely the interest motive (INT). As such, the interest motive (INT) showed no association with the altruism motive (ALT) or with the competence development motive (COM). Personal factors (PER), family influence (FAM), calling (CAL), and human orientation (HUM) appeared as missing motives in this epistemic network. Overall, most students with this profile (18, 54.5%) had a single motive, while 13 (39.4%) had two motives, and only two (6.1%) had three motives.

Lastly, the epistemic network of widely oriented humanitarians (Fig. 5) showed diverse interconnectedness of the motives, with human orientation (HUM) as the most prevalent motive at the center. It frequently co-occurred with the personal factors (PER), interest (INT), vocational qualification (QUA), and career and work (CAR) motives. All of the remaining motives were connected to one another with moderate or weak relationships. Family influence (FAM) appeared to have the least and weakest connections to the other motives in this epistemic network. There was no single motive that always appeared in isolation, and the students mostly showed more than one motive at the same time. In fact, only two (3.1%) students showed a single motive, eight (12.3%) students had two motives, 13 (20%) students had three motives, and 42 (64.6%) students had four or more motives.

RQ4: How are the motivational profiles associated with non-traditional PN students' study performance (GPA and study dropout)?

Statistical tests were carried out to explore what kind of relationship—if any—certain motivational profiles have with non-traditional PN students' study performance, namely general point average (GPA) and study dropout. Out of the 132 students, a total of 99 (75%) completed the PN training and obtained a vocational qualification in social and health care: 27 (79.4%) of the self-aware goal-achievers, 24 (72.7%) of the qualification attainers, and 48 (73.9%) of the widely oriented humanitarians.

The distinct motivational profiles of non-traditional PN students were compared in terms of the students' GPA, for students who completed the program (GPA was only available for 83 students). As presented in Fig. 6, the Welch ANOVA test comparing the GPA among the three motivational profiles showed that the difference was statistically insignificant ($F(2,43.68)=0.62$, $p=0.54$). According to a Chi-squared test, the difference in the proportion of study dropouts between the three motivational profiles was also statistically insignificant ($X^2 [df=2, N=132]=0.49$, $p=0.78$).

Discussion

This study aimed to gain novel insights into non-traditional practical nurse (PN) students' motivational profiles by harnessing the potential of institutional data and analytics in VET. In contrast to previous research, which has specifically examined the

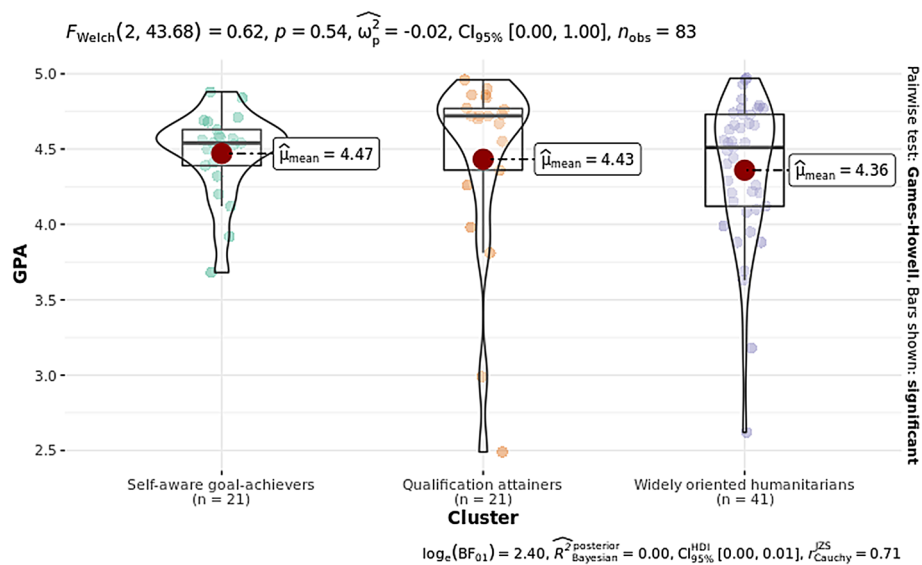


Fig. 6 Students' GPA comparison among motivational profiles using a Welch ANOVA

motivational drivers and characteristics of nursing students in higher education, this study addressed a group of students and a context that are less frequently studied. The study used a multi-pronged, mixed-methods approach that included examining the administrative institutional data (to identify distinct study motives), discovering the motivational profiles of students (to account for heterogeneity of motives), visualizing the discovered profiles using the novel epistemic network analysis (to examine the interplay of motives), and investigating the association between such profiles and study performance.

The qualitative content analysis (QCA) applied to the categorized motivational data identified nine distinct study motives that frequently occurred among the non-traditional PN students. These motives were partly consistent with those found in other studies, but there were also some differences. Similar to many nursing students in higher education (e.g., McLaughlin et al. 2010; Messineo et al. 2019; Mooney et al. 2008; Wilkes et al. 2015), non-traditional PN students in VET were also driven by pragmatic, professional rationales, such as improving career opportunities, possessing personally suitable factors or experiences for the field, and being able to work with or for people. Furthermore, they were similarly motivated by a desire to develop their competences and to act according to their own interests (e.g., Jirwe and Rudman 2012; Wilkes et al. 2015).

However, unlike many higher education nursing students in the studies cited above, but typical of non-traditional learners (e.g., Compton et al. 2006), the PN students in this study were particularly driven by the opportunity to obtain a vocational qualification, which highlights the instrumentality of training. Surprisingly, they seemed to place less emphasis on altruistic, prosocial reasons, such as helping and caring for people, or an innate desire to follow a professional calling, although this was found to be important in prior research (e.g., McLaughlin 2010; Messineo 2019). Moreover, the non-traditional PN students did not specifically highlight family influence, even

though it had been considered a key factor in some previous studies (e.g., Marcinowicz et al. 2016; McLaughlin et al. 2010; Mooney et al. 2008). Correspondingly, they did not emphasize family consideration as a specific outside responsibility behind their choice, although it did seem to drive many non-traditional students to pursue nursing education in a recent study by Dos Santos (2020).

These are relevant findings, considering that the work of PNs is strongly connected with providing practical aid and basic care to those in need, and calls for professionals who have strong enthusiasm and support for the field. Although not necessarily indicative of a lack of appropriate motivational factors among the non-traditional PN students, such characteristics may reflect the need to emphasize the prosocial aspects of training and future work when attracting potential applicants and providing such students with better targeted, motivational support. Facilitating the smooth acquisition of a vocational qualification seems particularly critical, as it prompts many non-traditional learners to pursue studies.

Instead of considering the students as a homogenous group in terms of their study motives, the investigation adopted a person-centered approach to discovering how these motives occur as unique combinations within and between the subgroups of students. A person-centered approach considers individual differences, accounts for the variations among students, and models the heterogeneity among students (Scotto Rosato and Baer 2012). The study discovered three distinct subgroups of non-traditional PN students whose motives were similarly combined and who thus shared a certain motivational profile: self-aware goal-achievers, qualification attainers, and widely oriented humanitarians. Self-aware goal-achievers considered themselves as having personal factors suitable for the field and strove to achieve not only a vocational qualification but also future career success and competence development. Qualification attainers, for their part, seemed to concentrate more on their current educational pathway, that is, obtaining a vocational qualification. Widely oriented humanitarians, on the other hand, were specifically motivated to work in a human-related field, but also indicated multiple other reasons for entering the PN training program. These profiles cannot be directly compared to those found, for instance, in the study of Messineo et al. (2019), as they clustered the students according to the quality and quantity of study motives. Nevertheless, the findings support the modern view that not all students “fit to the average” in terms of their motives, but instead tend to be driven by a complex mixture of several factors, some of which are more dominant than others (Hickendorff et al. 2018). Rather than a one-size-fits-all strategy that may not be optimal to guide all students, different approaches might be needed to provide students with the right support based on their motivational profile. This is particularly relevant among non-traditional students, who are found to benefit from guidance tailored to their specific needs (Moore et al. 2020).

Building on the notion that relationships matter, and that different motives are related to each other as a collective system of different interacting components which cannot be understood in isolation (Hilpert and Marchand 2018), this study sought insights into the motivational profiles of non-traditional PN students through epistemic network analysis (ENA). ENA was used to model the co-occurrence of study motives and the magnitude of their associations. In this study, the epistemic networks of the motivational profiles showed the connections between the prevalent motives, but more importantly,

also revealed links that would otherwise be difficult to detect. In the epistemic network of self-aware goal-achievers, for instance, calling, human-relation, and altruism motives had no connections to each other. In other words, having entered the training because of vocational calling was not associated with a desire of working with people or helping or caring for others. In the epistemic network of qualification attainers, in contrast, the interest motive was connected only to the vocational qualification motive: in fact, only two students combined these two motives, and only one student had the interest motive. In the epistemic network of widely oriented humanitarians, all of the study motives were intertwined with each other, that is, there was never a single motive that always appeared alone, and most students had more than one motive at the same time.

These findings underscore the notions of Hilpert and Marchand (2018), according to which learners hold a complex collection of several motivational factors that, as a whole, control the outcome and shape the learners' behavior. Therefore, modeling the motivational factors specific to a certain group of students as a network gives educators the opportunity to become aware of the patterns and structures of motives that underlie the choice of studies. Furthermore, it can better prepare them to meet students with different desires and intentions and to address the complexity of their study motives.

Prior research has found that certain motivational profiles of students, specifically when linked to some specific or multiple theoretical underpinnings, may associate with the students' learning outcomes (e.g., Gillet et al. 2017; Linnenbrink-Garcia et al. 2018; Steinmayr et al. 2019; Vansteenkiste et al. 2009). In the present study, the motivational profiles of non-traditional PN students did not show a statistically significant association with GPA or study dropout. There are explanations and lessons to be learned from these findings. An important point here is the grain level of the captured data—the time and context of reporting.

Here, study motives were gathered during the initial stages of studies, thus capturing a slightly different picture of the students' motives compared to perhaps more diverse motivational constructs investigated during education from one or more theoretical perspectives (e.g., Gillet et al. 2017; Linnenbrink-Garcia et al. 2018; Steinmayr et al. 2019; Vansteenkiste et al. 2009). Despite evidence of a connection between certain types of initial motives reported by students and subsequent study-related processes (e.g., Janke 2020; Nesje and Wiers-Jenssen 2023), the general motivational drivers found among PN students and used to create specific motivational profiles were insufficient as such to explain why some students perform better than others or drop out from studies. Rather than being predictors of future study success, such initial motives may remain merely "high hopes" unless they are associated with additional self-regulation and effective learning strategies as well as finely targeted support. Similar arguments have been presented, for instance, by Pintrich and De Groot (1990), who consider students' motivational beliefs as insufficient for success in their performance.

Another explanation for the lack of a true connection may lie in the context of admission, which does not necessarily bring out the range of motives, including those unfavorable ones, that could potentially function as significant factors for students' later study performance, such as study dropout. Thus, for educators and researchers seeking to examine such relations in greater depth, they may need to consider capturing motives across several time points and contexts, using more in-depth surveys and with other

dispositions, such as self-regulation and engagement, and grounding such investigations within relevant theoretical frameworks.

The institutional data and mixed analytical methods used in this study provided new perspectives on the motivational characteristics of non-traditional PN students that seem to be more or less intertwined within and between individuals. This information obtained through LA can be used to better inform strategies that enable more effective motivational support and ultimately also provide new ways to approach many educational challenges in PN training, such as improving attractiveness and designing well-targeted support. However, an in-depth insight into the actual motivational processes of students and their profiles requires a mature theoretical framework that is suitable for interpreting such institutional-level, motivational data. Accordingly, more progress in developing a theoretical underpinning is needed.

It seems that the availability of data in today's educational settings outpaces the progress into theory development, which is a known challenge in the field of LA (Dawson et al. 2015). At the same time, it highlights the importance of designing educational procedures, systems, and data collection processes for further analyses at vocational institutions in a way that not only considers data consistency and quality, but also draws on relevant learning theories for deepening the understanding of the various aspects of learning, such as study motives. As Marzouk et al. (2016) argued, a theoretical lens must be employed when generating data for input into analytics and for reflection on the various aspects of the data so collected. Addressing these issues gives the educational institutions a better opportunity to promote their technological readiness, organizational culture, and institutional capacity for a wider exploitation of institutional data and analytics, recognized in the literature as important elements in guiding the institutional implementation of LA (Colvin et al. 2017).

Limitations and future research

This study is not without limitations. First, it acknowledges the possibility of bias in the collected data, as it covered only a rather small proportion of non-traditional PN students. Additionally, the study placed a specific emphasis only on non-traditional PN students and ignored the traditional PN students, although obtaining educational data from both student groups would have been beneficial to gain an even more comprehensive understanding of the motivational drivers of PN students. This needs to be addressed in future research.

Second, the data has not been originally collected for research purposes, which has appeared, for instance, as slightly varying ways of obtaining and reporting information and storing such data in the student information system. Also, the information may have been impacted by the original context in which it was collected and the purpose for which it was collected. Instead of being a mere limitation, such authentic, unobtrusively gathered institutional data provided an actual starting point for the present study and promoted much-needed insights into the development of institutional practices that would enable systematic data collection and theoretically grounded in-depth analyses. However, the results must be interpreted and conclusions made with these aspects in mind. For the results to be applicable to a wider student population, more research is needed to make use of even larger datasets, preferably combining data from several

education providers, and thus providing a rich data source for the use of novel analytical methods. Moreover, future research would benefit from data acquisition processes that are initially planned and implemented in such a way that considers their further uses in analytics.

Finally, although this study provided relevant insights especially for the purposes of educators, the potential of analytics to generate insights regarding the students themselves was not particularly addressed. Thus, there is a need to expand the perspectives and results of this study to explore the potential of institutional data and analytics from the students' perspectives in future research, particularly asking what kind of LA reports and visualizations would support the students in their individual endeavors and motivate them to take the necessary steps to achieve their goals, and what kind of theoretical and pedagogical underpinnings are needed so that LA could better enhance not only the motivational aspects of their learning but also the wider development of competences needed in the future. As important stakeholders of LA, students should be engaged in its development through various methods, such as research (West et al. 2020).

Conclusions

The significance of this study relies on the use of institutional data and analytics to bring novel insights into the motivational drivers of non-traditional PN students for choosing their studies. By increasing the understanding related to the motivational profiles of students and the complex interplay between the study motives within such profiles, the study provides educators with the opportunity to design more-targeted motivational support and to inform strategies and decision-making to better meet the educational challenges faced by many PN students and, specifically, non-traditional learners. Based on the results, it is recommended that educators approach the students' motivational drivers from different perspectives and with various methods in order to draw a holistic picture of their diverse students and specific learner groups. For this, they need new measures and approaches, such as learning analytics (LA), that allow them to harness their educational data into novel insights, which can then be used as a part of educational processes and support services.

Introduction of institutional LA is particularly needed in the context of vocational education and training (VET), where its potential has remained largely unexplored. As this study demonstrates, LA within the context of VET is a promising venue to provide motivational support for students in different fields of training and to improve teaching and learning in various educational settings. However, it is suggested that vocational institutions thoroughly prepare their users, processes, and procedures for the meaningful and valid use of LA. This may require the development of institutional practices and a reconsideration of contextual factors to enable high-quality data, novel analyses, and actionable insights. As LA offers many interesting opportunities to contribute to the development of VET, its use should be invested in even more strongly in the future.

Abbreviations

ANOVA	Analysis of variance
FNAE	Finnish National Agency for Education
ENA	Epistemic network analysis
GPA	Grade point average
LA	Learning analytics

LCA	Latent class analysis
OECD	The Organization for Economic Cooperation and Development
OSF	Official Statistics of Finland
PN	Practical nurse
QCA	Qualitative content analysis
VET	Vocational education and training

Acknowledgements

Not applicable.

Author contributions

Conceptualization: RK, SL-P, MS, LH. Methodology/formal analysis: RK, SL-P, SV, MS, ES, LH. Software: SL-P, MS. Writing—original draft: RK, SL-P, SV, MS, ES, LH. Writing—review and editing: RK, SL-P, SV, MS, ES, LH. Visualization: SL-P, MS, RK. Funding: LH. Supervision: LH. All authors read and approved the final manuscript.

Funding

This research was funded by Business Finland through the European Regional Development Fund (ERDF) project “Utilization of learning analytics in the various educational levels for supporting self-regulated learning (OAHOT)” (Grant No. 5145/31/2019). The article was completed with the grant (Grant No. 25221232) from the Finnish Cultural Foundation's Central Ostrobothnia Regional Fund, which was awarded to the first author.

Availability of data and materials

Not applicable.

Declarations

Competing interests

The authors declare that they have no competing interests.

Received: 25 November 2022 Accepted: 25 September 2023

Published online: 21 October 2023

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