ASCILITE 2023

All you need is love (for data): Enhancing practicum experiences for sport and exercise science students through learning analytics

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This study illustrates the potential of data-centric methodologies in enriching the practicum experiences of Sport and Exercise Science (SES) undergraduates. By amalgamating learning analytics and text mining, we extract actionable insights from practicum reflections. Automated report generation and data visualisation techniques enable quick identification of students requiring intervention, while text mining and sentiment analysis decode the prevalent themes in practicum experiences. The resulting insights potentially enable personalised, data-informed support strategies, fostering improved student satisfaction, practicum outcomes, and industry-relevant course design. The fusion of data and pedagogy illustrated in this research underscores the potential for data-driven strategies in enhancing tertiary education.

Keywords: Data-driven Approaches, Decision Support Systems, Sport and Exercise Science, Student Monitoring.

Introduction

Within the Sport and Exercise Science (SES) practicum, the bridge between theoretical knowledge and practical application is essential. Student reflections from these practicums are valuable yet underutilized, largely due to the time and inconsistency issues involved in manual analysis. This study illustrates how the use of learning analytics and text mining can extract significant insights from these reflections. Furthermore, the research highlights the role of process automation, through coding, in streamlining the data analysis, underscoring the potential for data-driven strategies to augment practicum experiences and support mechanisms in tertiary education.

Practicum for professional accreditation

In Australia, SES students need to complete a minimum of 140 practicum hours across key competency domains for Exercise and Sport Science Australia (ESSA) accreditation (ESSA, 2019). Though critical to connecting theory and practice, the full potential and challenges of this experience are yet to be tapped (James et al., 2021). The logbook method used to document these hours, presents an opportunity to enhance aspects of reflective practice and mitigate practicum challenges such as technical competencies and communication skills (Gooi et al., 2021). The hurdle of real-time analysis of this data to improve student experience and identify at-risk students is significant (Farrah, 2019). Deploying digital technologies for tracking student practicum experiences may provide a path to navigate these issues and foster adaptive interventions.

Data for student insight generation and decision support

In the digital era, data-driven strategies, such as learning analytics and text mining, provide comprehensive support for students during practicums. Learning analytics, the process of collecting and presenting learner-related data, enables a learner-centred approach that balances technology and human factors (George & Dragan, 2012). This approach has shown success in monitoring learning, predicting performance, and identifying at-risk students (Wong, 2017). Similarly, text-mining in pre-service teacher education has been used to automate reflective journal assessments (Chen et al., 2016). These techniques can offer insights into student development, skill gaps, and success barriers in the context of SES practicums. The merger of pedagogy and technology embodies the evolution of hybrid pedagogies, highlighting the complexity of teaching and learning in the digital era. This research has two objectives. First, we integrate data analytics and automation within the SES practicum processes. This not only elucidates the areas requiring pedagogical enhancement but also helps identify students who may benefit from additional support, thereby reflecting the principles of learning analytics. Secondly, we

employ text mining and sentiment analysis to unravel themes within practicum experiences, which will deepen our understanding of SES students' perceived needs.

Methodology/Approach

In this study, we applied data analytics techniques to analyse practicum logbook reflections from 96 students undertaking the Bachelor of Sport and Exercise Science program at an Australian University. The data, collected from the PebblePad digital logbook platform in 2022-2023, consisted of secondary information that students had logged to meet ESSA's professional accreditation practicum requirements. We used R (version 4.2.1) and R Studio (version 2022.12.0 Build 353) for automating and performing the data analytics processes. Ethical approval for this study was received from the institutional ethics committee (HEC22167).

Capitalising on learning analytics in practicum experiences

We adopted a data-centric approach to augment the practicum experience. Key strategies comprise automated report generation, student progress monitoring, and individualised sentiment analysis. These techniques enable both students and educators to gain actionable insights during crucial transitions, leading to a more engaged and informed practicum journey. The rest of this paper provides an overview of how these were used and their practical implications for students and academics.

Automated parameterized report generation

In the context of our work, we incorporated the concept of parameterized report generation to automate and streamline the process of creating individual student logbook reports. This automated process utilized R code to read the database of student logbook data extracted from PebblePad, thereby creating a systematic and reproducible method for report generation. With an R Markdown template, we generated personalized reports for each student (Figure 1 below), reducing errors and boosting efficiency. These reports, complete with data visualizations of practicum hours, competencies, and reflections, assist students with progress tracking and reflection.
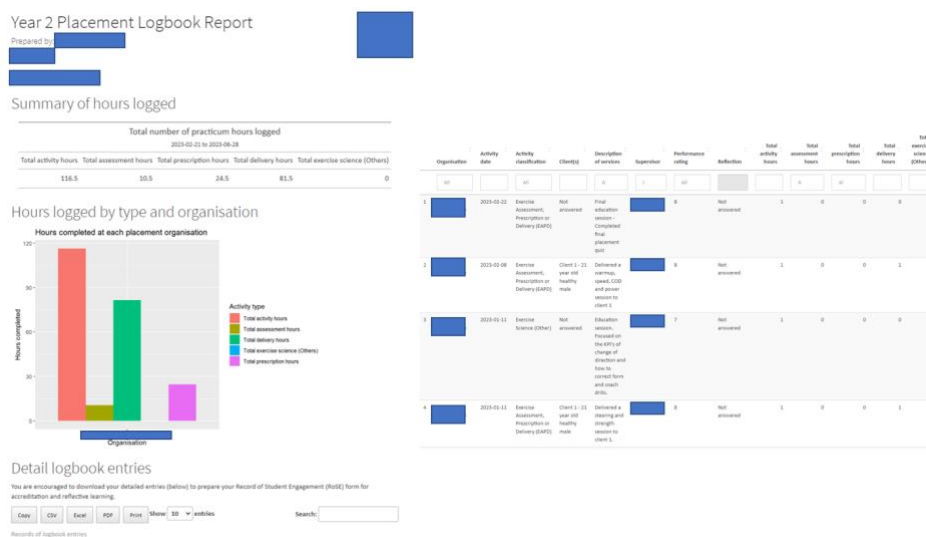
Figure 1: Sample interactive student report

Concurrently, staff reports (Figure 2 below) aggregated from the same data source inform course management, demonstrating the scalability and efficiency of this automated approach. In a testament to this method's efficacy, over 100 individual reports were generated within a minute.
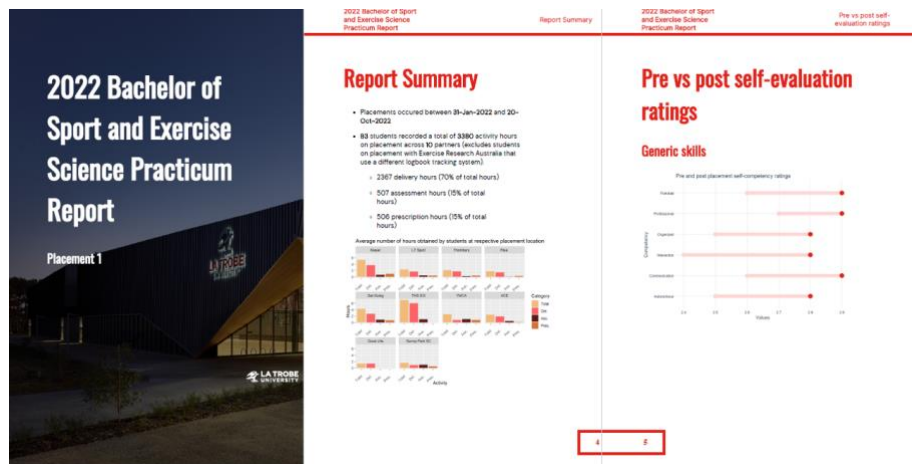
Figure 2: Staff insight report

Data visualization for student progress monitoring

Data visualisation was a key part of our response strategy, offering an instant snapshot of each student's practicum progression. It enabled quick identification and prioritisation of students falling behind in practicum hours during the semester (Figure 3 below). These insights can foster proactive communication with industry partners, creating a collaborative environment focused on student success. The strategic application of data visualisation and learning analytics enhanced the practicum experience by informing both reactive responses and proactive strategies to ensure timely completion of practicum hours.
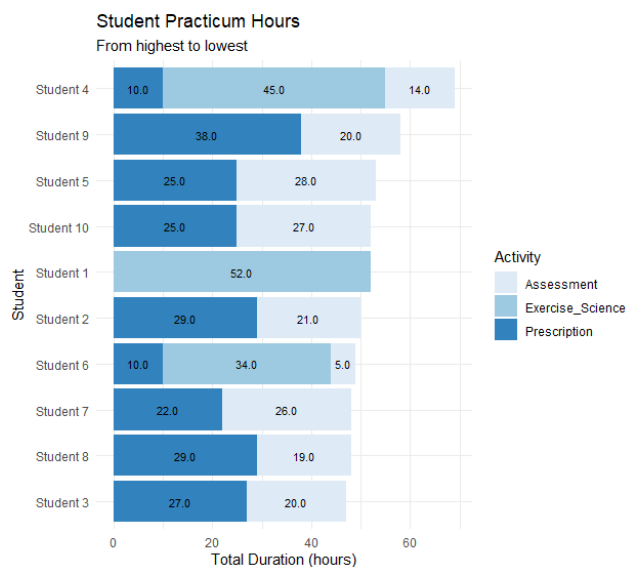

Figure 3: Data visualisation tracking student practicum hours across key competencies, revealing potential imbalance and identifying slow-progress areas.

## Student success monitoring using process control charts

The application of control charts, traditionally used in industrial quality control, provides a data-driven approach for gauging sport and exercise science students' practicum experiences. These charts not only trace individual student performance over time but also pinpoint outliers in self-reported ratings (Figure 4 below), facilitating the identification of students frequently reporting suboptimal experiences. This graphical representation can foster timely interventions by supervisors, allowing for nuanced detection of performance and experience changes. Such a data-driven approach ensures tailored student support irrespective of cohort size, ultimately elevating the quality of practicum experiences.
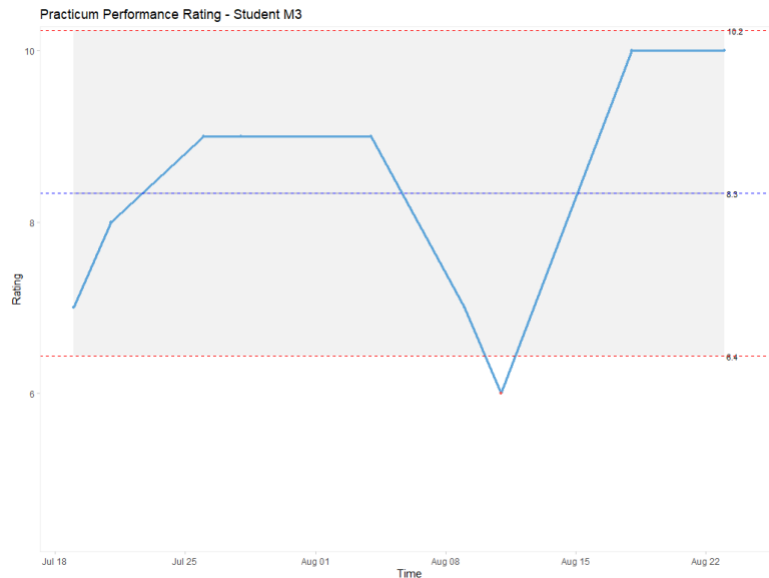
Figure 4: Example control chart with a student's rating scores during practicum. Central line indicates the average rating, with the upper and lower control limits (red dashed lines) reflecting the typical range. Points beyond these limits suggest unusual instances in the student's performance.

Extracting sentiment and themes from student reflections using text-mining

In understanding the practicum experiences of sport and exercise science students, the use of text-mining techniques in their narrative descriptions is invaluable. By designating "Good" days as those where students self-rate their performance as 7 or above and "Bad" days as those rated 3 or below, we gain insight into their perceived performance in relation to their experiences using open-ended reflection responses. Bigrams, which are pairs of consecutive words, were extracted from these descriptions, providing rich and context-specific information. Through bigram analysis visualization (Figure 5 below), we distilled key themes from students' practicum experiences. Bigrams from "Good" days typically indicated successful interactions or engagements, whereas those from "Bad" days hinted at stressors like overwhelming tasks or insufficient support. Recognizing these patterns allows educators to reinforce positive elements and address recurring challenges more effectively. This innovative approach optimizes student learning experiences during the practicum by offering a nuanced understanding of their experiences.
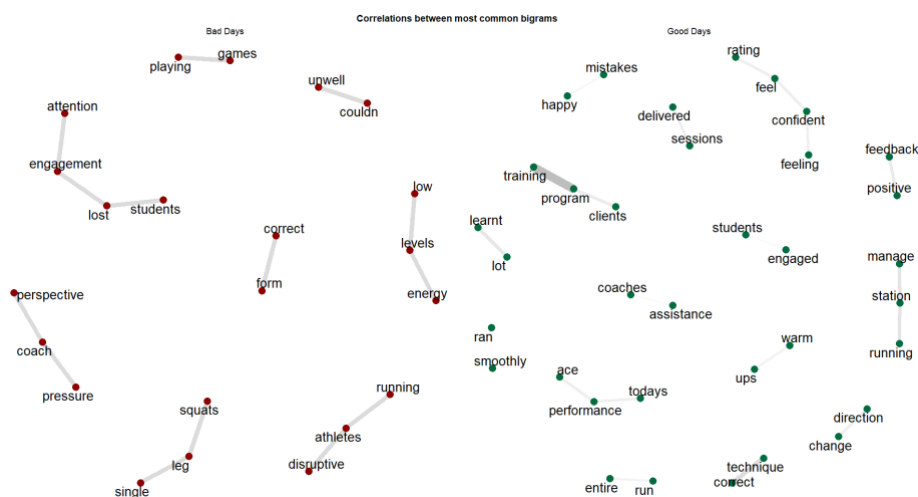
Figure 5: Bigram Co-occurrence Networks for Good and Bad Days. Nodes depict distinct words, with edges showing words that pair often in sentences. Edge thickness and transparency signify bigram frequency. The left illustrates 'Bad' days data; the right, 'Good' days.

Complementing this, our sentiment analysis deepened our grasp of students' emotional journeys during their practicum. By uncovering sentiments linked to specific reflection entries and spotlighting problem areas often overshadowed by standard ratings, we can decipher the multifaceted nature of student experiences (Figure 6 below). Our interactive sentiment plot uniquely allows academics to interactively probe instances of persistent

low scores, facilitating a direct insight into the corresponding reflections. For instance, pinpointing a particular data point would reveal the exact sentiment, such as struggles due to a dip in athlete motivation.

Figure 6: Sentiment plot for students with persistent low scores. Each line depicts a student's sentiment progression (values below the black horizontal line deemed as negative sentiments), with data points marking specific reflection entries. The mouse over point reveals a reflection: 'Due [to] last week's term, athletes started [to] lack motivation [and] got distracted easily [SIC]'. Interactive plot here: https://shorturl.at/cdnqN

Conclusion and implications for practice

The implementation of data analytics and text mining techniques promises far-reaching implications for wider educational practice, allowing institutions to optimize practicum experiences across disciplines. Their scalability and efficiency can accommodate large cohorts, offering personalized insights and real-time identification of at-risk students. As tertiary education continues to evolve, embracing these data-driven methodologies could be key to enhancing student learning experiences and driving pedagogical innovation.

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