Optimising postgraduate supervision using multilevel modeling techniques in a constrained higher education environment

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A B S T R A C T

The paper developed a multilevel model (MLM) of postgraduate (PG) supervision to improve academic publication and PG completion rate. Crowdsourcing essentials were used in the development of the model. The crowds consisted of the MLM made of students from Honours to doctoral levels. Teamwork was also applied, where the teams were level mates and supervisory teams. The simplest form of the model has potential to generate over 65 academic manuscripts for journals. Monitoring of the supervision process can provide maximized completion of the PG research studies. Research capacity building would be affected for the doctoral and master’s students making them able to supervise and co-supervise from Honours to doctoral levels upon completion of their own studies. The study condemned use of a single supervisor for several doctoral students. It recommended the implementation of the model (the MLM PG Supervision Framework). It further recommended that doctoral students should be assigned co-supervisors, preferably varied for different students, to enable diversity in the supervision experience.

Introduction

The ideal number of postgraduate (PG) students that a supervisor of doctoral thesis should supervise varies usually depending on the context and the level of support that is available (Lee, 2019). Common factors include faculty workload, funding, the level of supervision required, research quality and time management skill. Many universities have guidelines that specify the maximum number of PhD students a professor can supervise, which is usually three to four students. However, De Lange et al. (2011) point out that in large universities, a study on doctoral supervision and support states the ideal number of students to be between 12 and 18 with three to four promoters. In a small university of less than 6000 students at the undergraduate (UG) and PG levels, the ideal number of PG students that a supervisor of doctoral theses should supervise can vary depending on various factors (Stapleton, year). Stapleton further remarks that PhD supervisors want many PhD students to drive their academic career. He states that they need to publish many papers, and the only way to do that is to hire a massive workload of PhD students and postdocs to do the research work that credits them as well.

However, the actual number can depend on various factors such as the level of support available, the nature of the research, and the capacity of the supervisor. A survey of doctoral supervisors in South Africa found that the ideal or maximum number of students that a single supervisor can effectively supervise is often debated (Mouton et al., 2015). The quality of supervision is crucial, and supervisors should ensure that they can provide adequate support and guidance to each student under their supervision (Cekiso et al., 2019). Therefore, the ideal number of PG students that a supervisor can effectively supervise will vary based on the specific circumstances and the capacity of the supervisor to provide quality guidance and support to their students.

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A virtuous PhD supervisor should have a record of accomplishment of supervising PhD students through to completion, a strong publication record, sufficient time to provide adequate supervision, genuine interest in the project, and a supportive personality (Phillips & Johnson, 2022; Wisker, 2012). The student supervisor ratio should be able to maintain adequate mentorship and support for the students. This study aim was to design a multilevel model that can optimise student supervision experience at the doctoral level.

Literature review

Theoretical and Conceptual Background

Supervision outcomes

When supervising a PG student for an academic study in this modern day and era, a manuscript for publication is one of the expected outcomes (Zepeda, 2013). More papers is even more desirable. The students under supervision are also expected to learn more about research. If in this exercise there are new co-supervisors to be roped in, it is also an added advantage as the capacity for research is increased. The ultimate goal of eth whole exercise is completion and then graduation. These are not the only possibilities, as, according to Newell et al. (2009), experienced PG supervisors who are also innovative are usually able to convert their students to be innovative as well. When there are innovative skills, the value that a supervisory relationship can produce has no small limit. On the other hand, when the supervisors lack skill, knowledge and experience in supervising, there is a risk of poor results and even non-completion of the study.

Essentials of an academic study

Academic writing has several essential elements that are crucial for a successful study outcomes (Lee, 2019. These include a standard organisational pattern, clear and logical explanations, and the integration of scholarly sources into the arguments and discussions. According to Bailey (2003), a characteristic academic paper should consist of an introduction, the main body, and a conclusion. Some of the papers even require an abstract, which is a concise precipitate of the whole paper. Additionally, academic writing should maintain a formal tone, use third-person perspective, and demonstrate a clear focus on the research problem under investigation. It also requires precise word choice and the use of clear, logical, and simple explanations to communicate complex ideas.

Academic writing usually condenses these complex ideas in a thesis statement, the statement that encapsulates the primary idea of the paper (Nadkarni & Prügl, 2021). Through the thesis statement, the goal of the writing can be easily understood. Every other discussion that is included in the research paper must support and point to the thesis statement. The research aim, which is a long-term intent of the study, explains this thesis statement. Then the study objectives are another way to condense the thesis. Research objectives specify the thesis in detail, which are the issues that the project plans to investigate, as they build on the main theme stated in the research aim. Normally at least three research objectives are stated (Kreber, 2023).

Academic hierarchies are important in the formulation of the aim and objectives of studies at various levels (Cruess et al., 2019). Experience, backed by several researchers (Orlovic Lovren et al., 2020; Sharp et al., 2017), shows that an objective formulated for a doctoral study should be adequate to provide a quality study at the master’s degree level. Moreover, an objective formulated for a master’s degree study should be adequate to provide a quality study for an Honours degree level (Hsiao et al., 2023). This paper assumes that the objectives will appear as an enhanced research topic and not in clear loose form to mirror its home in the doctoral studies.

Who should supervise a PG research study?

This section discusses the ideals faculty for supervising a PG research to achieve the minimum requirements and expectations as explained. In a PG study, a typical academic who holds a higher qualification such and has experience in the specific research area of the student's study typically provides the supervision (Kamler & Thomson, 2014). This can mean that an experienced master’s degree holder can supervise an Honours project, and a PhD degree holder with experience should supervise a master’s degree study. There are plenty of examples where master’s degree holders supervise master’s degree research projects (Bjarnason et al, 2015). In the case of a doctoral research, since there is no higher qualification than a doctoral degree, all the doctoral studies are supervised by doctoral degree holders who have extensive experience in PG supervision at an advanced level (Ives & Rowley, 2005; Ramnorwalo, 2022). The qualification attainment transpires through the successful supervision that the PG student receives. However, knowledge, skill and experience to supervise wait for training and opportunity. This means that effective supervisors are developed, and should be developed (Lee, 2007).

Teamwork

Teamwork refers to the collective effort of a group of interdependent individuals who work together towards achieving a conjoint goal, or to complete a task in an effective and efficient way (Handke et al., 2021). Without the outcome of effectiveness, there is generally no point in teamwork. Effective teamwork is indispensable to an enterprise's success, because it encourages mutual and personal growth, escalates job satisfaction, added-value outcomes, and reduces stress, among other benefits (Feng et al., 2017). According to Kozlowski and Bell (2019), the crucial characteristics of a successful team include a common or shared goal, interdependence, boundedness, stability, the individuals’ ability to manage their own work and internal process, and to operate in a
bigger social system. Six (6) components of balance of member contributions, collaboration among team communication, cohesion, coordination, effort, and mutual support are essential to the effectiveness of teamwork (Fathin & Raharjo, 2023). According to Chen et al., (2023), working in collaboration with each other is the only way to accomplish a team’s shared goals. Collaboration allows people to know each other’s skills, personalities, and areas of expertise, which can lead to a stronger, more developed team. Teamwork enhances productivity, promotes resilient working relationships, and allows employees with diverse skills, experiences, and ways of thinking to blend their skills and efforts to generate new concepts and renewed ideas.

By implementing these strategies, you can create a more collaborative and supportive work environment, leading to increased productivity and success. One can be to leading by example in which teamwork and collaboration are shown effective through actively participation in team activities, and setting an encouraging example for others to follow (Aksekili & Stettina, 2021; Cha et al., 2015; Dayan & Di Benedetto, 2008; Strode et al., 2022). Another is by setting clear and achievable goals for the team to ensure that every team member understands their roles in reaching the set goals. Encouragement of social goals can follow with organising of team building events and activities to foster stronger relationships and trust among team members. Clarifying each individual’s role is vital to make sure that all team members understand their responsibilities and the way their contributions affect the team’s total success. Effective communication is key, which should be open and honest to encourage team members to share their views and ideas. When team members exercise together, with team members engage in group physical activities or exercises, it can reinforce teamwork and nurture a sense of companionship. Team rules and purpose are important and should be established. This can take place by creating and sharing guidelines for team conduct and decision-making, and highlighting the importance of collaboration and mutual support. Time should be managed efficiently by encourage team members to prioritise tasks and meet deadlines, and ensuring that all team members are aware of their responsibilities and progress. It can be beneficial to share enthusiasm and positive feedback by recognising and celebrating individual and team accomplishments, promoting a positive and motivational work setting. Leaders should be open to feedback and learning. This can happen by encouraging team members to share their viewpoints and proposals for improvement, and open up to effecting changes to enhance teamwork.

Crowdsourcing

Crowdsourcing involves a thoughtful process of gathering work, information, or opinions from a hefty group of people, which can be done through the internet, social media, and smartphone apps (Vahdat-Nejad et al., 2022). It can involve numerous tasks, which include creative and design work, data entry, and problem solving. It enables enterprises to access countless skills and expertise without incurring the costs of hiring additional employees. Crowdsourcing benefits include cost-effectiveness, faster problem solving, a hands-off approach, fresh perspective, and access to a diverse talent pool, making it a valuable resource for businesses looking to innovate and solve problems (Bronson, 2022). According to several researchers (Cammarano et al., 2022; Grimaldi, Vermicelli & Cricelli, 2022; Mishra & Maheshwari, 2023), there are best crowdsourcing practices with which businesses can attach the power of crowdsourcing to generate innovative solutions, reduce costs, and improve overall efficiency. One can be by making innovation a priority for leadership. This can be through encouraging leaders at every enterprise level to lead efforts for progressive change and innovation, across all aspects of the enterprise. Another way could be to offer incentives for participating, by rewarding everyone who contribute their useful ideas. A suitable platform for crowdsourcing, which supports the needs and goals of the enterprise’s needs to be selected. User experience should be made easy and smooth by making the submission process easy by using apps or platforms designed for crowdsourcing. Clear guidelines should be established, and clear guidelines and instructions should be provided for participants to ensure that the ideas they submit are relevant and high quality. There should be monitoring and engagements with participants. That is, the crowdsourcing process should be actively monitored, feedback should be provided, and questions or concerns should be addressed to keep participants motivated and engaged. Then there should be evaluation and implementation of ideas. Thus, after collection and appraisal of the submitted ideas, the leading solutions should be selected and implemented.

Crowdsourcing and team work intersections

Crowdsourcing and teamwork often overlap in modern crowdsourcing, as complex tasks may require teamwork and collective labour can be addressed (Vinella et al., 2022). The massive crowd scale makes forming project teams a difficult problem to coordinate manually. Hence, most crowdsourcing collaborative platforms can depend on algorithms to automate team formation based on worker profiling data and task objectives. Similarities of crowdsourcing and teamwork can be addressed through various team formation models, with bottom-up and hybrid (bottom-up and top-down) approaches generally promoting better collaboration and satisfaction among workers. Peculiarity and team dynamics also play a crucial role to shape the success of crowdsourcing projects, and harnessing inherent teamwork knowledge can assist to improve the quality of tasks that have been crowd-sourced.

Multilevel modelling

Multilevel modelling (MLM-ling) refers to a statistical technique for analysing data that are structured hierarchically or as a cluster (Heck & Thomas, 2020; Hox et al., 2017). Other names for MLM-ling are hierarchical linear modelling, mixed models, nested models, and random effects models. Such data structure emerges when individual data points are nested within larger groups. One can think of students within classrooms, or patients within hospitals. Multilevel models (MLM) permit the estimation of parameters that differ at several levels. They are mostly beneficial when the data have a nested or hierarchical structure. They are normally applicable in fields such as education research, geographical research, psychology, and sociology. MLMs can account for the hierarchical data structures in which observations cluster within larger groups.
Research and Methodology

Study design
The study design consists of an algorithm based on MLM-ling to expose possible benefits of using it in a supervision of a number of students to increase benefits of capacity building, supervision success and maximising publication of research manuscripts in academic journals.

Algorithm context
The study context is a higher education institution (HEI) offering degrees from UG to doctoral levels, the doctoral degree having minimum three (3) years and master’s degree having minimum two (2) years to complete. For doctoral degrees, a minimum of two (2) published manuscripts while master’s students are required to publish a single (1) manuscript. In the first year, both the master’s and doctoral students should receive clearance certificates after successful submissions to technical and ethical committees applicable in the HEI. The PG Honours is one year, as the case of most South African HEIs.

Supervisory teams
Consider a supervisor with five (5) doctoral students. Assume that each of the studies has three (3) objectives at least. Assuming quality objectives as pointed out earlier, then at least 15 objectives that are available can be given to master’s students for their own studies. Each of the five (5) doctoral students can be appointed to co-supervise the students taking their objectives. At the (2) 15 master’s level, three (3) objectives each gives 45 topics for the Honours students, and 15 co-supervisors who are at the master’s level.

Supervisory processes

Designing levels
The principal supervisor at level 4 in charge of the doctoral students is the overall project leader. At level 2 are the five (5) doctoral students who were turned to become master’s supervisors. At level 3 are the 15 master’s students turned co-supervisors of the Honours projects. Then at level 3 are the 45 Honours students.

Supervision management
The main supervisor at level 4 is the main facilitator. At the beginning, timelines are set for the Honours, masters and doctoral projects. Due to the urgency of the Honours projects, their timelines should come first. For the doctoral students, the main supervisor is always in charge. For the master’s, at the start, the main facilitator is in charge as the main supervisor. Gradually he/she can give some responsibilities to the co-supervisors, with the intent to give them full responsibilities while he/she oversees and monitors. Monitoring should be to determine progress on the pace of the study, development of manuscripts, quality of the work, and if guidance to the supervised students is appropriate. The main supervisor will give feedback and when necessary, he/she will provide corrective action.

Manuscript development protocols
As a start to generating manuscripts and boosting publications, an attempt could be made to have a research manuscript for each of the Honours students, and a manuscript from each objective from the dissertations and theses at the master’s and doctoral studies. There should also be encouragement that students attempt to produce other manuscripts from their work apart from directly focussing on the objectives.

Results
The crowd sourced consists of at least 66 individuals; level 1 of 45 Honours students, level 2 of 15 master’s students, level 3 of 5 doctoral students, and level 4 of supervisor or supervisors. A minimum of 65 manuscripts developed from the objectives of all the studies, noting that the master’s and the doctoral studies could still have several secondary and tertiary objectives that were not documented.

Figure 1: The pictorial basic multilevel model as described above
The five (5) doctoral students receive training to supervise at the master’s level while the master’s students can be ready to supervise the Honours students, and also co-supervise the master’s students when they undertake the doctoral studies. Since there is still deficiencies in the numbers of supervisors in South African HEIs, this capacity building will be handy when recruiting PG students. Larger numbers of PG students can be admitted because of supervision availability.

For effecting supervision, there is a team of doctoral students and another team at the master’s level that can work together and collaborate if necessary. Then there are also teams where groups of master’s students co-supervised by each doctoral students can report and present at the same time. These teams can be useful to each other when members in a team agree to critically read the work developed by their peers before submission to supervisors and towards presentations (if applicable).

As the students at each level are given the same timetable, and there is monitoring of the progress, the chance is little that anyone can fall behind, and if they do, they will not fall behind too far. This means that for most students, anyone falling behind has a great chance to catch-up.

Discussion

Crowdsourcing and teamwork express to be at the helm of the success of this MLM supervision guideline. A large crowd of 66 unique individuals whose presence adds value to the activities of others is amassed. The model provides a potential to generate at least 66 academic manuscripts.

Apart from the manuscripts, there is research and supervision capacity building for the various student groups. Each single student learns to develop an academic paper from his or her studies for journal submission. The doctoral students can be to supervise at the master’s level on their own after obtaining their doctoral degrees, and to co-supervise at the doctoral level. The master’s students can be ready to supervise the Honours students, and to co-supervise the master’s students when they undertake the doctoral studies.

During the process of undertaking their studies, several student level groups have peers that can review their work. The Honours and master’s groups have immediate mentors and guides to assist them when they have challenges, as the doctoral ones can assist both. For all these groups, there is also monitoring and evaluation that can benefit all the students. It was also shown that the chance to fall behind is slim for any student at every level, and that anyone falling behind can recover and still make the required time for the expected submissions.

One huge drawback on the assumption of a single main supervisor is that there is no multiplicity for so many students. Also, if this main supervisor becomes incapacitated, this means that the 66 students at three PG levels will not graduate. Moreover, some of the 66 envisaged papers may not make it to the publication status. Physically as well, the main supervisor may be inadequate to manage and handle 65 students at three PG levels as we know, there are more other tasks to be done.

Conclusion

The model has strengths and limitations. Building research capacity and amplified research publications are the immediate notable strengths. The success of the MLM as a framework to optimise doctoral supervision and induced effects at both the master’s and the Honours can be a great success in mass production of quality PGs, researchers and supervisors. There is monitoring and evaluation of progress, and the chance to miss out for any student is slim.

The number five (5) of doctoral students was given as an example because of the constrained indicated in the paper title, where student numbers are limited. In the case of the main supervisor being alone, it was more for argument and the intent to apply mathematical induction. Larger universities with plentiful resources could involve more supervisors and more doctoral students connected to a single supervisor, resulting in heightened outcomes and benefits. The inclusion of co-supervisor is usually never impossible, as external supervisors are solicited whenever necessary. The limitation of the model is the assumption of only one main supervisor for these doctoral students, and no indication of co-supervisors.

This study recommends that the MLM PG Supervision Framework be implemented with improvements according to the setting requirements and capabilities of each HEI; and supervisor incapacitation.

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