Supervisors' approach and other factors contributing to the successful completion of doctoral studies

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Introduction and Literature Review

The purpose of this paper is to explore factors that impact on the successful completion of doctoral studies in Engineering. This includes factors relating to the supervisors' approach as well as the students' attributes. A paper "Masters of Engineering Management: Graduation rates lagging growth rate" was published and presented at the IEEE Frontiers in Education Conference (Marnewick & Pretorius, 2016). It contained findings about master's students in the Engineering Management Programme at a university in South Africa. The research presented in this paper continues with this theme that focuses on PhD studies aimed at the role of the supervisors' approach. The Engineering Management Post Graduate Programme has been in existence at a South African Higher Education institution for more than 20 years. The present student population is 340 master's and 100 doctoral students. The student enrolment numbers have seen significant growth over the last decade. Unfortunately, the dropout rate or long duration before completion of studies at both master's and PhD level is still very high. The School graduated 90 master's and 15 doctoral students in 2018. This respectively represents 45% and 37% of the graduates of the Faculty of Engineering and the Built Environment.

Similar lower completion rates for PhD students have been mentioned to be problematic in literature e.g. on a 10 year basis 64% is quoted for Engineering, 63% for life sciences and 56% in social sciences (Young *et al*., 2019). The implication is that between 36% and 46% of PhD students do not complete their studies in a 10 year cycle. This attrition rate seems rather high. This is also borne out by PhD attrition studies mentioned in sources and research reports where it is stated that "seven years after finishing the humanities coursework, only about 41% had completed the doctoral program" (Roberts *et al*., 2019). Having said this, it is also mentioned that studies on PhD graduate experience and success factors are scarce (Mohamed *et al*., 2012). In this vein the growth rate of PhD researchers in a group context has also been illustrated to be somewhat moderate at a South African university, especially in the forming stages of the research group (Pretorius & Pretorius, 2006).

Some of the reasons for relatively lower completion rates for PhD studies may be found in the approach of supervisors of PhD studies. It seems important to briefly address at least some supervisory approaches that are typically found in the literature on PhD studies. The theoretical framework for PhD supervision can be embedded in pedagogy as the methods related to the research process. Some of these pedagogical elements of PhD supervisory approaches are also discussed in research literature (Dietz *et al*., 2006; A.M. Lee, 2007; Pearson, 1999; Pearson & Brew, 2002). Authors even refer to the focus on supervisory approaches against the problem of the attrition rate of PhD students as "timeous" (van Schalkwyk *et al*., 2016). The research on supervisory approaches presented in this paper is thus also deemed to be relevant in the discourse on the relationship between the PhD student and supervisor. Here reference can be made to the work of Nawaz (2018), *The pedagogy of good PhD supervision*. Elements of the research supervision models mentioned in pedagogy literature are proposed as follows: Functional, critical thinking, enculturation and relationship development are integrated in the discussion on effects of the supervisor in the PhD journey presented here (A.M. Lee, 2007; A. Lee, 2008). The relationship approach to supervision may also be shown to be useful when considered in a team-based approach to

research. The supervisor acts in a research team in collaboration with the PhD student as for example that of the supporter where the aim is to support the PhD student to complete the PhD thesis within a reasonable time span in accordance with the academic requirements of the university. This is supported by the team-role approach of Belbin and others (Thamhain & Asgary, 2013; Fisher *et al.*, 2001).

Some identified factors influence PhD success positively. These include elements such as supervisor-student relationship, mentorship and the dissertation process itself (Young *et al*., 2019). Here mentorship can include support for issues that the student may encounter such as health and other personal hurdles. This also relates to the emotional and managerial support factors mentioned in studies such as those focused on ways to ensure improved success (Roberts *et al*., 2019).

The remainder of this paper is organised as follows: The introduction explains the motivation and appropriate literature employed in this research. The next section addresses the research aim, questions identified as well as research methods utilised. A further section focuses on discussing the results and analysis of the research. The paper concludes with a summary and comments on the supervisory approaches identified for the PhD student sample population and two PhD supervisors. It includes some basic comparisons to previous literature on the topic of the PhD supervision process.

Research Purpose and Method

The sample population (94) for this research focused only on those PhD students supervised by the last two authors, either on their own, together as supervisor/co-supervisor or supervisor/co-supervisor with other supervisors.

The research method employed in this research is case based. The case study method is useful when the aim is to obtain a deeper understanding of a specific context. In this research the context focused on is very specific, namely two PhD supervisors and their supervisory approach as experienced by some of their PhD students. It can also be mentioned that the research is exploratory, an approach indicated to be useful in the early stages of a research project that may be expanded on later (Cooper & Schindler, 2014; Yin 2003). The research was approved by the ethics committee at University of Johannesburg.

A list was compiled of all the students supervised by the last two authors, including their e-mail addresses. Due to time lapsed, not all students' e-mail addresses were available to the supervisors. Efforts were made to obtain updated e-mail addresses. The survey was sent to 35 students via e-mail of which 31 completed surveys were returned. This resulted in a response rate of 89% based on the students with available e-mail addresses. This sampling method can be described as convenience sampling, because participants were selected based on availability (Cooper & Schindler, 2014). Useful results can be obtained and due to the high response rate the sample is representative and volunteer bias is considered to be minimal.

Some of the success factors identified in literature as discussed in the previous section were employed in constructing a survey using a research questionnaire and assessing the results. This questionnaire consisting of ten questions with six open-ended questions was compiled for students who had completed their doctoral studies. The open-ended questionnaire analysis was done by the author who was not involved in the supervision of these students assisting in negating research bias. The responses were analysed and grouped into themes using text analysis and into common codes. This analysis is therefore qualitative.

A few biographical closed questions were asked, one of them about years of experience before students embarked on their doctoral studies. This was done to ascertain the usefulness of industry experience when doing a PhD.

The open-ended nature of questions is useful to allow the respondents freedom of expression in terms of supervisor approach and experiences during their studies without being too prescriptive. The next set of open-ended questions addressed the following issues:

- What do you value in your supervisor/s approach to your doctoral studies?
- What did your supervisor do to encourage you in your work?
- Was there anything more that you would have appreciated from your supervisor?
- What skills and competencies do you believe are necessary for doctoral candidates to successfully complete doctoral studies?
- What difficulties did you experience/what hindered your progress?
- Any further feedback/comments?

Lastly, the following three five-point scale questions in a more quantitative manner addressed some specific relationships in the research team:

- How important do you view the relationship between the supervisor and student?
- How important do you view the relationship between supervisor and co-supervisor?
- How important do you view having more than one supervisor per student?

Both supervisors completed a questionnaire addressing the following set of questions. This was done before the students' feedback was obtained:

- Which of your competencies do you consider beneficial for successful supervision?
- What skills and competencies do you value most in PhD candidates that in your opinion also enhance successful completion?
- In your opinion, what attributes of PhD students hamper success?
- What common difficulties did you encounter in supervising PhD students?
- How did you overcome them?
- Any further feedback regarding supervision?

Results

Students' Feedback

Figure 1 indicates that most of the students (71%) had at least 11 years' experience before starting their doctoral studies. This maturity profile contributes positively to the successful completion of doctoral studies; this may be attributed to the fact that in a workplace environment and everyday life, they had already successfully managed and completed projects.

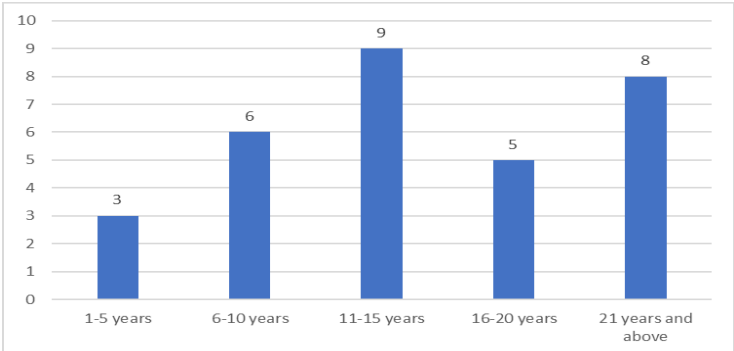

Figure 1: Number of years' work experience before commencing with doctoral studies

The results of the open-ended questions are presented in Tables 1–6. The percentages mentioned in the tables were calculated based on the percentage of the total number of themes indicated by all respondents. Percentages below 5% are not shown in the tables due to space constraints.

Table 1: What do you value in your supervisor/s approach to your doctoral studies?

Communication, quick feedback, discussions, being available	24%
Supervisor's experience, knowledge, direction, sees the bigger picture	24%
Autonomy, freedom, flexible, not dictated to	14%
Personal interest in topic, confidence in me, keep me motivated, encourage, relationship	14%
Understanding topic, field of study, understanding research process	8%
Narrow down, remain on track, research focus	6%
Joint supervisors, research process guidance	5%
Timelines, key milestones, time management	5%

In Table 1 the value of the supervisor's approach is for example illustrated by the respondents in terms of communication and supervisor's experience. These two sets of themes combined contribute to 48% of the responses. They are therefore considered to be important feedback from the respondents. Autonomy and flexible research are also indicated as positives by the respondents in terms of the third highest category at 14%.

Some verbatim comments from the respondents that support the resulting themes in Table 1 include:

> *Freedom to explore the scope and depth of the topic, to make a more refined definition as the work progresses.*
>
> *I valued their honest and direct comments, they were very good at guiding me. Their guidance provided me a direction and goal to work towards. They really made an effort to understand what I was trying to convey and how to bring that message out within the correct context of the research.*

Table 2: What did your supervisor do to encourage you in your work?

Feedback, communication, meetings, supervisor available	30%
Supportive, motivating, mentor, coach, believe in myself	23%
Supervisor's experience, guidance, knowledge	17%
Timelines, key milestones, time management	13%
Autonomy, freedom, flexible, not dictated to	8.5%
Supervisor's personal interest in topic	8.5%

Table 2 demonstrates that 70% of respondents feel that feedback, support, motivation and experience from the supervisors encouraged them to perform. This is reflected for example in the following verbatim comment:

> *He was very supportive during my doctoral studies. Encouragement for me during the research was that he trusted me to progress within my time ability and capability.*

Table 3: Was there anything more that you would have appreciated from your supervisor?

Nothing, they did all one can expect	75%
Group meetings with other students	8%

Table 3 illustrates that 75% of the respondents were satisfied with the supervisors' approach. This is supported by for instance the following quotes from respondents.

Nothing, both my supervisors assisted me whenever I needed help.

I was very happy with and motivated by my supervision.

Table 4: What skills and competencies do you believe are necessary for doctoral candidates to successfully complete doctorate studies?

Research knowledge, methods, protocols	19%
Self-driven, motivated, project-driven, mindset, performance under pressure, determination, can do attitude	17%
Work experience, knowledge of field	11%
Communication, language skills, scientific writing, writing skills	10%
Time management, put in the time, prioritisation, planning	10%
Critical thinking, analytical thinking, innovative thinking, cognitive skills	8%
Mature, self-confident, energetic	8%

Table 4 indicates that research knowledge, project approach and work experience account for more than 47% of the factors indicated by the respondents as required skills and competencies to successfully complete the studies and is supported by the following quotes:

The student must be mature with a "can do attitude" approach to the research. The student must have a number of years' practical work experience in the industry.

I believe the key skills would be:- ability to work alone, time management, capacity for imagination and creativity as well as analytical skills, interpersonal skills, group work, team projects, negotiations, networking and other critical social skills

Table 5: What difficulties did you experience/what hindered your progress?

Work-life balance, time constraints, study, family, impact on personal life, priority	48%
Too broad, needed to narrow down, re-focus	10%
Unpreparedness for PhD (knowledge and expectation)	10%
Response time from participants	10%
Health, chronic illness	10%
None	10%

As illustrated in Table 5, 48 % of the respondents indicated that work balance and time constraints hindered progress in their studies. This can possibly be attributed to the fact that the majority of PhD students in this sample worked in industry. In the question asking for further comments no significant further comments were indicated (No comment 72%).

Table 6: Relationship importance in the research team?

How important do you view the relationship between the supervisor and student?	Strongly disagree	1	2	3	4 13%	5 87%	Strongly agree

How important do you view the relationship between supervisor and co-supervisor?	Strongly disagree	1	2 3%	3 16%	4 23%	5 58%	Strongly agree
How important do you view having more than one supervisor per student	Strongly disagree	1	2 6%	3 42%	4 29%	5 23%	Strongly agree

As indicated in Table 6, the relationship between the supervisors and students is important (87% strongly agree). The majority (52%) of respondents agree that co-supervision adds value to the team and the students' experience. Only 6% of the respondents seem to not value the role of the co-supervisor.

Supervisors' Feedback

Themes identified from the supervisor responses are summarised in Table 7.

Table 7: Supervisors' feedback

Supervisor competencies	Competencies valued most in PhD candidates
• Experience knowledge in field of engineering • Understand what a PhD is and the process • Know when there is a contribution/when to stop • Able to adapt to the topic • Allow students to develop their own style • Treat all students with respect • Clear on what is expected and specific in feedback • Own experience in industry (fulltime work & consulting)	• Experience in the field • Self-motivation • Understanding of what is needed for a PhD, also the work involved • Knowledge of the field • Takes time/time and effort involved/needed
Attributes of PhD students hampering success	**Difficulties encountered in supervision process**
They must fundamentally understand what it takes to make a contribution Part-time studies and balance with work and family life Consistent and hard work Motivation to finish and perseverance Not taking the supervisor's feedback seriously	Stressful to make the decision re when it is enough Student's misconceptions about time-lines and "new knowledge"

For the response from the question, any further feedback, not indicated in the table, the following response is noteworthy: "*A doctorate is the only qualification where someone else must also learn something from you. All qualifications below doctorate you have learned from others. Ensure that this is highlighted in your work.*"

Similarities in feedback from students and supervisors

Themes that correlate are summarised as follows from Tables 1-7.

What competencies do you consider you have that are beneficial for successful supervision? linked to *Value in your supervisor/s approach:*

- Experience and knowledge in field of engineering
- Understand what a PhD is and the process

- Know when there is a contribution/when to stop
- Able to adapt to the topic
- Allow students to develop their own style
- Relationship: support, teamwork, role model, motivate
- Clear on what is expected and specific in feedback/focus on end goal

What skills and competencies do you value most in PhD candidates that also in your opinion enhance successful completion? linked to students' question about *What skills and competencies do you believe are necessary?*

- Experience in the field
- Self-motivation/goal setting: ability to drive the end goal
- Understanding of what is needed for a PhD, also the work involved/takes time/time and effort involved/needed/focus
- Knowledge of the field
- Critical and original thinking

In your opinion, what attributes of PhD students hamper success? linked to *Hamper success:*

- They must fundamentally understand what it takes to make a contribution
- Part-time studies and balance with work and family life/personal circumstances/work/life/study balance
- Lack of motivation to finish and lack of perseverance/lose focus

Conclusion and Discussion

From Tables 1-5 the majority percentage themes identified for each research question seem to complement and relate to the supervisors' themes identified from a supervisors' perspective. For example knowledge, direction, autonomy, supervisors' experience, communication, work experience, self-driven and research knowledge are all factors that can be inferred from both perspectives. If one compares some of these supervisor results/themes with the lower scored themes in some of the students' feedback it is notable that for example mentoring and coaching also specifically feature.

If we consider that all the responses were received from successful students, this may indicate that the approach utilised and aimed at by the supervisors seems to have had a positive effect on the majority of students. This statement that the supervisory approach employed is successful is for example supported by the 75% positive response from the PhD students demonstrated in Table 3. This may then be utilised by supervisors and future students to motivate them towards success and earlier completion of their PhDs.

The supervisors also experience stress during the supervision process, especially in deciding when the contribution to knowledge is acceptable. In summary the results would seem to indicate that both supervisors follow an approach of supervision that is non-linear or flexible and is adapted to the strengths of specific candidates as well as the stage of completion of the particular research projects. This is borne out by the students' responses in Table 2. This can be related to a team and coaching approach for supervising PhD students. These approaches of both the supervisors and students can be positively linked to some previous literature on for example critical thinking and relationship development as well as the team-based approach (A.M. Lee, 2007; A. Lee, 2008; Thamhain & Asgary, 2013).

The results of this paper thus indicate that the supervisors' approach is in a sense unique as it integrates elements of a number of supervisor approaches and does not follow a specific model for each student. The supervisors are adaptable in their approach depending on the student's needs and his stage of research. The pedagogical model used is also adapted to the student skill set and stage of the PhD research. The empirical results from the case study presented in this paper seem to support this conclusion. The unique case-based research method with some limited results presented in this paper, however, limits the generalisation.

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