# Mechanical engineering students' perceptions of workplace mentoring: A case study at a South African University of Technology

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**SESSION: C1: Integration of theory and practice in the learning and teaching process**

**CONTEXT** Work placement, a form of work Integrated learning (WIL), is a planned period of learning in industry that is intended to give students practical experience of their field as well as meet specified learning objectives. Researchers claim that effective mentoring is one of the antecedents of successful student learning during placement. In South Africa, the National Diploma in Mechanical Engineering has a prescribed work placement duration of twelve months. From 2019, the work placement duration will be reduced to six months. The reduced duration demands accelerated workplace learning, that can be achieved through adoption of strategies such as effective mentoring, to offset the WIL benefit tempering effect of the shortened duration

**PURPOSE** The research question for the study as follows: How do various conceptions and elements of workplace mentoring influence mechanical engineering students' perceptions of its effectiveness?

**APPROACH** This paper reports on a qualitative study that is based on 21 cases of mechanical engineering students from a single university of technology in South Africa. Qualitative data was collected through interviews, and from student work placement logbooks. The data was analysed using the Miles and Huberman's approach to develop patterns, themes, and clusters which were then compared with the core concepts of traditional and cognitive apprenticeship frameworks.

**RESULTS** It emerged from the study that the efficacy of mentoring during work placement depends on the interaction of pre-placement expectations versus work practicalities, perceived mentor qualities, mentoring functions, mentor-protégé relationship and the learning environment. Pre-placement expectations clouded the students' judgement of the quality of mentoring that they received during their placement. Unrealised expectations affected how they perceived their mentor, how they participated in the mentor-protégé relationship and their response to the industry mentors' mentoring functions. The learning environment during placement provided an opportunity for students to recognise limitations in their own knowledge and afforded them the opportunity to develop learning strategies that they can use to acquire industry specific heuristic tactics that are essential for competent performance.

**CONCLUSIONS** The study found that pre-placement expectations vs work practicalities-, mentoring functions, mentor-protégé relationship and the learning environment are the key drivers of the mentoring process and the resulting workplace learning. The study also found that most WIL mentoring is ad hoc. Industry mentors adopt mentoring functions that are not aligned with a particular apprenticeship approach. The adopted techniques fit in-between traditional and cognitive apprenticeships.

**KEYWORDS** workplace mentoring, work placement, students' perceptions

# Introduction

Work integrated learning (WIL) in the form of work placement has been part of the diploma offerings of South African Universities of Technology since their inception. Work placement is a planned period of learning in industry that is intended to give students practical experience in their field, as well as meeting specified learning objectives. Helyer and Lee (2014) claim that the work experience provided by WIL is one of the best ways to improve student employability. Tong and Kram (2013) claim that the accelerated learning curves that have been shown amongst mentored workers, highlight mentoring as one of the strategies that can provide faster competency development.

The duration of work placement for the post-1993 mechanical engineering national diploma programme is twelve months. This is about to change as the diploma, in its current format, is going to be phased out in 2019. It will undergo several changes and will henceforth involve a work placement duration of six months. This reduced work placement duration demands accelerated learning to offset the WIL benefit tempering effect of the shortened duration (Coll et al., 2009).

Eby, Brown, and George (2014) define mentoring as a dyadic developmental relationship embedded within the organisational context between a more experienced individual, a mentor, and a less experienced individual, a protégé. They note that mentoring can be formal (initiated by an organisation) or informal, even naturally occurring (initiated without organisational involvement).

Mentors provide both vocational and relational support to their protégés. Lankau and Scandura (2002) indicate that vocational support is geared towards facilitating technical learning within the context of work. The mentors provide their protégés with learning opportunities and guidance that promote development of technical competency. Lankau and Scandura (2002) further indicate that relational support assists the protégé to understand the interconnectedness of workplace roles, functions, and people. They explain that mentors also expose their protégés to their networks, providing them with access to expertise and views that would otherwise not have been available to them.

Vocational mentoring during WIL mostly takes an apprenticeship-like approach. During WIL, mentoring can be ad hoc or take the form of either traditional apprenticeship or cognitive apprenticeship, depending on the nature of the skills that are to be taught and the circumstances of the workplace. Collins and Kapur (2014) state that during traditional apprenticeship, an apprentice works very closely with the expert, referred to as the master, and is supervised in every aspect of the learning experience. Collins, Brown, and Newman (1987) indicate that traditional apprenticeship focuses on teaching skills in the context of their use: within the situated learning environment. They claim that the skills that are to be learned are inherent to the task itself. Collins, Brown, and Holum (1991) explain that traditional apprenticeship is suited to teaching performance of tasks whose required skills are externally visible; that is, readily available to the student for observation. In their view, traditional apprenticeship is amenable to teaching crafts such as welding, boiler making, fitting, and turning and plumbing.

Brown, Collins, and Duguid (1989) explain that cognitive apprenticeship differs from traditional apprenticeship in that it focuses on cognitive aspects of performance, rather than psychomotor skills. Both traditional and cognitive apprenticeship use observation, coaching, and scaffolding as teaching and learning strategies (Collins, 2006). However, cognitive apprenticeship extends teaching to include the mostly cognitive strategies of articulation, reflection, and exploration. Collins and Kapur (2014) claim that cognitive apprenticeship promotes competency development by bringing the master's strategic knowledge into the open, thus allowing the apprentice to engage with it. They state that the acquisition of strategic knowledge allows apprentices to generalise learnt skills; to know when a certain skill is applicable and to be able to transfer their gained skills to novel situations.

Eby et al. (2014) write of the challenges they face in giving practical advice to mentors and protégés on how to develop effective and beneficial mentoring relationships. They attributed these challenges to the gap that exists in literature regarding causal mechanisms of effective mentoring. They propose personal learning as one of the causal mechanisms for effective mentoring.

This paper proposes another causal mechanism, namely the protégé's perception of the effectiveness of mentoring as a teaching and learning strategy. In contextualising this study, the researcher sought to answer the question: How do various conceptions and elements of workplace mentoring influence mechanical engineering students' perceptions of its effectiveness? In-depth understanding of these elements and conceptions would be indispensable to the development of efficacious mentoring strategies that will work in short-duration work placements.

## Approach

This paper reports on a qualitative study that is based on 21 cases of mechanical engineering students from a single university of technology in South Africa. The students were selected from a sampling frame of 245 students, using maximum variation purposeful sampling. Maximum variation purposeful sampling is preferred in studies that seek to discover patterns that cut across diversities of experiences. Participants of the study were sampled across nationality, type and location of host company, and prior exposure to work experience. One of the WIL coordinators served as a key informant for the study and assisted in identifying participants who fitted the study criteria.

The study made use of interviews and student logbooks as the primary sources of data. It also used observation to assist the researcher understanding the context of students' experiences. Interviews were transcribed and logbook texts were retyped within Computer Assisted Qualitative Data Analysis Software (CAQDAS). The qualitative data was analysed using Miles and Huberman's approach. Initial codes and categories were developed from the first six cases. These were processed into patterns, themes, and clusters by comparing them with the core concepts of traditional and cognitive apprenticeship frameworks. A further fifteen cases were used for checking the plausibility of the patterns and for verification of the conceptual/theoretical coherence of the clusters and patterns.

## Results

Five themes were identified within the mentoring cluster as constituting key aspects of mentoring during work placement: pre-placement expectations versus work practicalities, perceived mentor qualities, mentoring functions, mentor-protégé relationship and the learning environment.

### Theme 1:     Pre-placement expectations versus work practicalities

Students' evaluation of the effectiveness of workplace mentoring was clouded by their pre-placement expectations. Some of the students' expectations were reinforced by those of the University which were outlined in the learning manual. The University expects mentors to expose and guide students to achieve the University's WIL learning outcomes. Students expected mentors to have a working understanding of the WIL student learning manual. This was not always the case, as highlighted by Student 21:

> As compared to what I read in my manual, there is a manual that we have for in-service. What I have experienced so far, it's just a complete opposite. When I read the manual, there is expectations from the company and there are expectations from me. There are not into the party, that company. (Student 21)

It seems, from the students' perspective, that their mentors had to navigate trying to meet the expectations of their employers, the students, and the University while balancing the

constraints of daily work. Mentoring is a time-consuming exercise. Consequently, organisations need to free up some mentoring time. This was not possible in cases where senior staff served as mentors and resulted in availability challenges. For example, Student 8, whose mentor was responsible for two branches of the company, reported the following:

> *At the moment, the Quality Manager[mentor] is in PE. He comes maybe once in a week, once a month, to come check this site, how it is, so I tell him, then we write our logbooks, then I ask him to sign for what I have been doing. I interact with him over the phone and all that.* (Student 8)

## Theme 2:    Perceived mentor qualities

Students' perceptions of workplace mentoring were moderated by their expectations and conceptions of what constitutes good mentoring. Students indicated that they preferred to be mentored by a supervisor who has the following qualities:

*1.    The mentor should be technically knowledgeable*

Students had a low opinion of mentors who were not able to provide solutions to their technical challenges or direct them to where they would get help. If they thought that a mentor was not knowledgeable about something, they tended to avoid the mentor and tried to solicit help from their developmental networks: their co-workers, university peers and family members. For example, Student 1 said the following:

> *I asked my mentor if the thing is going to work, the only thing he said was like, "I have no idea what is going on there"… I speak to the guys, I hear how great their bosses are with them, how much they help the students.  Like, most of the feedback I get from other students is how much they enjoy the in-service and how much they get helped.* (Student 1)

*2.    The mentor should have prior experience of mentoring students*

Students preferred mentors who have experience in mentoring students. They believed that such mentors know what is expected of them by the University. Student 4 suggested that one of the reasons for him having a valuable experience was because:

> *There were many students before us. They do run a big in-service programme. I think they're meant to take two every six months.* (Student 4)

*3.    The mentor should be willing and accessible to mentor students*

Students preferred mentors who were accessible and willing to attend to their challenges and concerns. They became frustrated in cases where their mentors had taken a long time to respond to their concerns. Student 5, who indicated that he had a positive WIL experience, reported the following about his interactions with his mentor whom he said assisted him settling in an unfamiliar role of managing mechanical engineering projects:

> *If you have any issues, fabrication, any questions, literally anything you want to know, you go to him. He's more than willing to help. No matter how silly your questions seems.* (Student 5)

*4.    The mentor should not be too senior within the organisation being unable to spare sufficient time coaching students*

Students reported that it was not always a good thing if the mentor was at a senior level in the organisation. They regarded a good mentor to be one who is senior enough to be able to allocate authentic and meaningful tasks to the students, but not too senior so as to be accessible when needed. Students equated seniority with lack of availability. In response to a question on who his mentor was, Student 4 said the following:

> *Yes, it started out as the GM of the company, but the GM was often away and too busy for us, so it ended up being one of the senior project managers that have been there.* (Student 4)

## Theme 3:     Mentoring functions

Students expected their mentors to coach their integration into the workplace, support them in their learning efforts, and facilitate opportunities for meaningful engagement in work activities. Student 13 aptly described this expectation as follows:

> *The one thing is that a student goes to in-service to be to be mentored, and treated right, and shown how everything is done.* (Student 13)

Students also expected from mentors to ensure that their work activities were properly sequenced, based on their current and expected competence levels. In addition, mentors were also expected to facilitate students' attainment of expected work performance. In most organisations, the students served real organisational functions. Therefore, they were expected to become productive as soon as possible. Sometimes this resulted in students being given complex and demanding tasks too soon. These students felt as if they were thrown into the "deep end and expected to swim".

In other cases, students performed the same functions throughout their placement period. Thus, they continued to perform certain work functions long after their learning potential had been fully exploited. Mentors were expected to ensure that students' work functions served both organisational and competence development goals. Some students were aggrieved that their mentors were more interested in achieving organisational goals, compromising the WIL learning outcomes in the process.

## Theme 4:     Mentor-protégé relationship

In this study, the mentor was usually a departmental supervisor or manager. Mentorship was assigned based on the person's position within the organisation. It was not uncommon for a mentor to have several protégés. In cases where the supervisor was unavailable, a substitute mentor was assigned. In all the cases, there was minimal choice, particularly from the protégé's side, on who their mentor would be. However, this does not mean that students were passive recipients of mentorship. They exercised personal agency. They actively managed their relationship with their mentor. For example, Student 4 – whose mentor was prone to outbursts of anger – indicated that she maintained a good working relationship with her mentor despite his frequent outbursts by avoiding him when she sensed that he is likely to shout at someone.

> *You become an operator and then you move into the CNC office. Once you're done with that, then you move on to becoming a junior project manager and you manage small projects .… I had a good relationship with my mentor…  And he will come back and shout at that person because it took eight hours instead of four. You had to walk circles around him.* (Student 4)

The mentor-protégé relationship was not unidirectional. It was affected by student behaviour, work ethics and proactiveness. Mentors were more likely to allocate meaningful and authentic tasks to students who were proactive. The impact of student personal agency was highlighted by Student 19's experience; she was ignored by her mentor until she proactively asked him to be included in work assignments, which was transformative. Her recollection of the experience also shows that mentors learn from their protégés too:

> *I actually stood up and went to my supervisor and I asked him if I would work outside with the guys. And he didn't mind because to him, it is like I am not even there. Then I went and worked with the guys. After, – it was actually after two weeks – I went to him again and told him that I now want to do maintenance, then he put me with somebody else and then after that week, I went to him again and said  that now I want to do pumps. He was actually getting used to the system and that I was there. I started getting invites to the meetings, plant meetings, cost meetings. I started being treated well and all those things. I started travelling to other plants as well.* (Student 19)

Student 19's mentor will likely adopt a different approach should he or she mentor another student in future.

**Theme 5: Learning environment**

Students expected their mentors to facilitate their exposure to meaningful and authentic work tasks. They also expected their mentors to teach them industry-specific knowledge and heuristic strategies that they would use to tackle work challenges. They recognised that classroom learning does not provide them with opportunities to learn both domain and heuristic knowledge. Student 1 aptly summarised the key limitations of student knowledge before commencing work placement training and how mentors can add to a student's knowledge base:

> *The main thing he helps me on is what we didn't study. We don't know how big a pillow block bearing for this type of problem should be. And where can I get this and where can I get that. But the design is my own. The building and the design is my own but he helps me on where I can get the stuff, will this part fit and the specs and stuff like that but the design work is my own. It's not stuff that one would study from a book.* (Student 1)

# Discussion

A key concept that has emerged from the study is that the efficacy of mentoring during work placement depends on the interaction of pre-placement expectations versus work practicalities, perceived mentor qualities, mentoring functions, mentor-protégé relationship and the learning environment. A schematic representation of this interaction is shown in Figure 1.

Pre-placement expectations were the lens through which the students saw mentor qualities. Perceived mentor qualities influenced the way students responded to their mentors. Students developed a negative attitude towards mentors whom they perceived as not technically knowledgeable, unavailable, or unwilling to provide the required guidance. In such circumstances, students turned to their developmental networks for guidance or resorted to soliciting third-party mentoring.
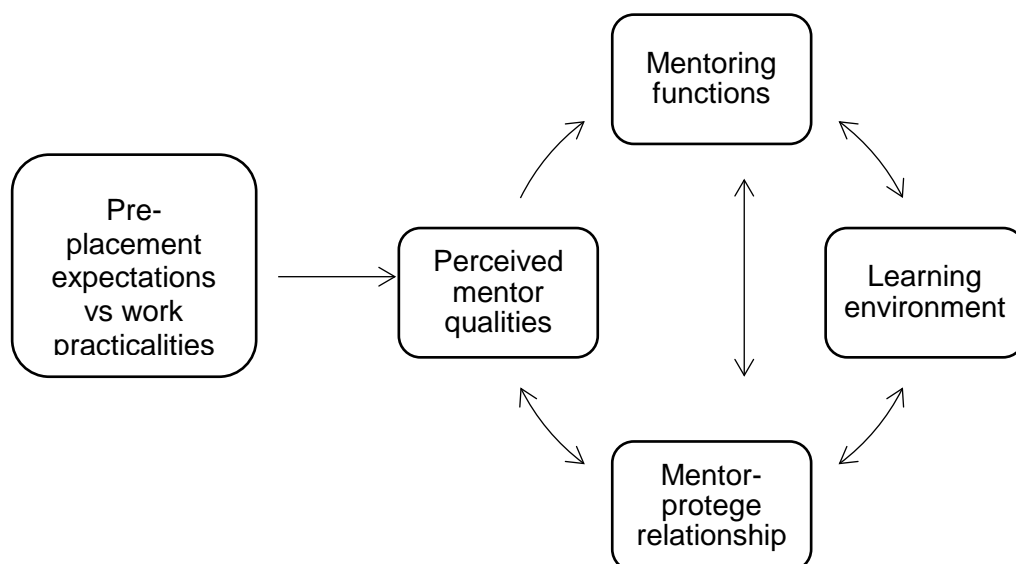


**Figure 1: Relationships between mentoring elements during work placement**

The mentor-protégé relationship is bi-directional; its development depends on both the student and the mentor. When it thrives, it has a positive effect on perceived mentor quality and the learning environment. On the other hand, poor mentoring and an ineffective learning environment may cause a breakdown in the mentor-protégé relationship, which in turns exacerbate mentoring difficulties. In two cases during this study, such breakdowns in the

mentor-protégé relationship had a further reciprocal effect on the mentoring functions and continued to circle out. A fixable challenge, such as mentor availability, produced mentor-protégé conflict that escalated to the point of the protégé leaving the organisation. However, in instances where students felt that they would still benefit from staying on, they found a way of managing the mentor-protégé relationship. As per Bandura's (1997) assertion, students are active participants in their learning. This was demonstrated in this study through student proactivity and its impact on the mentor-protégé relationship.

Mentoring functions also influence the mentor-protégé relationship. Students who were given complex work assignments during the initial period of their placement felt alienated and developed resentment towards their mentors. Students expected their mentors to guide them in their work and to give them time to grow into their roles. One of the students commented that they cannot be expected to master in twelve months the skills that their full-time colleagues took years to perfect. Engineering students in the study by Coll et al. (2009) expressed similar sentiments about the limiting effect of short duration WIL, although the students participating in that study were in work placement only three months. It seems as if the challenge has more to do with the timing of been given complex tasks. Students expected their mentors to protect them from the taxing demands of the workplace. They considered paced learning without the pressure of a full-time job as one of the major benefits of work placement. When that support was not forthcoming, the students developed resentment. It seems as if a mentor-protégé relationship is key to the perceived success of the work placement.

A combination of mentoring functions constitutes a mentoring approach. In this study, mentors mixed and matched functions depending on the circumstances. A mentor would coach and provide scaffolding to his protégé, but would not afford the protégé an opportunity to observe as the mentor performs an activity. In the study, mentors followed an ad hoc approach; choosing what works while considering the time and organisational constraints. The mentoring reported in this study did not follow the sequential phase of cognitive apprenticeship as outlined by Collins and Kapur (2014); it fitted somewhere between traditional and cognitive apprenticeship.

Another key concept that emerged from the study is students' perception of the nature of knowledge that is required for competent performance in the workplace. The students believed that the acquisition of heuristic knowledge and people skills are the major benefits that are gained from work placement. This is similar to the findings reported by Eby et al. (2014) that mentoring aids a protégé's personal learning. The students recognise that the broadness of the mechanical engineering field and the nature of the industry-specific knowledge that is required, make it impossible for universities to address all the knowledge and skills that students require to be work-ready. Work placement programmes provide students with the opportunity to recognise the limitations of their own knowledge and to develop learning strategies that they can use in acquiring the necessary knowledge and skills. They consider the knowledge gained at university as a springboard for obtaining industry-specific and heuristic knowledge that is required for work readiness and employability.

# Conclusion

Students' perceptions of the effectiveness of workplace mentoring are clouded by their pre-placement expectations. The study found that pre-placement expectations versus work practicalities, mentoring functions, mentor-protégé relationship and the learning environment are the key drivers of the mentoring process and workplace learning. The study's findings seem to indicate that the mentor-protégé relationship has a pervasive effect on mentoring and learning. Its bi-directional nature is a key influencer of the perceived success of the work placement. The study also found that most WIL mentoring functions are ad hoc. They are not aligned with a particular apprenticeship approach. Lastly, the study found that an effective

mentoring process assists students in acquiring industry-specific and heuristic knowledge that is required for competent performance.

## References

Bandura, A. (1997). Self-efficacy: The exercise of control (1st ed.). New York: WH Freedman and Company.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 42.

Coll, R., Eames, C., Paku, L., Lay, M., Hodges, D., Bhat, R., … Martin, A. (2009). An exploration of the pedagogies employed to integrate knowledge in work-integrated learning. Journal of Cooperative Education & Internships, 43(1), 14–35.

Collins, A. (2006). Cognitive apprenticeship. In R. K. Sawyer (Ed.), The Cambridge Handbook of The Learning Sciences (1st ed., pp. 47–60). Cambridge: Cambridge University Press.

Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: making thinking visible. American Educator, 15(3), 6–11, 38–46.

Collins, A., Brown, J. S., & Newman, S. (1987). Cognitive apprenticeship: teaching and craft of reading, writing and mathematics. University of Illinois-Center for the Study of Reading: Champaign.

Collins, A., & Kapur, M. (2014). Cognitive apprenticeship. In R. Keith Sawyer (Ed.), The Cambridge Handbook of the Learning Sciences (2nd ed., pp. 109–127). New York: Cambridge University Press.

Eby, L. T., Brown, B., & George, K. (2014). Mentoring as a strategy for facilitating learning: Protégé and mentor perspectives. In S. Billett, C. Harteis, & H. Gruber (Eds.), International handbook of research in professional and practice-based learning (1st ed., pp. 1071–1097). New York: Springer.

Helyer, R., & Lee, D. (2014). The role of work experience in the future employability of higher education graduates. Higher Education Quarterly, 68(3), 348–372. doi.org/10.1111/hequ.12055

Lankau, M. J., & Scandura, T. A. (2002). An investigation of personal learning in mentoring relationships: Content, antecedents, and consequences. Academy of Management Journal, 45(4), 779–790. doi.org/10.2307/3069311

Tong, C., & Kram, K. E. (2013). The Efficacy of Mentoring – the Benefits for Mentees, Mentors, and Organizations. In J. Passmore, D. B. Peterson, & T. Freire (Eds.), The Wiley-Blackwell Handbook of the Psychology of Coaching and Mentoring (1st ed., pp. 217–242). Chichester: Wiley-Blackwell.