Adaptive Expertise and Perceived Work Performance among University Lecturers during COVID-19 Pandemic

Master's Thesis

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SUMMARY

The ability of people who can work successfully in non-standard situations can be called adaptive expertise. The organisations need employees who are increasingly adaptable, versatile, and able to face emerging challenges in the world. An example is the COVID-19 pandemic which created an altered academic environment in the universities. Therefore, university teachers had to perform their routine duties in a non-standard situation which highlights the importance of having adaptive expertise among them. This study investigated significant dimensions of adaptive expertise in a group of university teachers and its relationships with perceived work performance, work experience and academic ranking in this altered academic environment.

The latest literature identifies that adaptive expertise has three dimensions, Domain, Metacognitive and Innovative skills. A tool developed to measure adaptive expertise (Carbonell et al, 2016) was used to collect data from 40 university teachers at the University of Twente. The questionnaire included 17 items of the three dimensions, demographic data, and questions about perceived work performance. It was administered online. Descriptive statistics, EFA, CFA and Spearman's Rank Correlation were used for analysis.

Domain and innovative skills were identified as the significant dimensions of adaptive expertise of the sample, while metacognitive skill was not identified as such. A higher mean score for the domain skill (4.26 out of 5) than that for innovative skill dimension (3.87) indicated a greater contribution of the domain skill dimension to the adaptive expertise among university teachers. Adaptive expertise scores showed positive correlations with perceived work performance ($r= 0.41$) and academic ranks ($r=0.42$) but not with their work experience.

This study reconfirmed the results of Carbonell et al. (2016), who have reported that the domain and innovative skills are the key dimensions of adaptive expertise. However, it is difficult to exclude the metacognitive skill from the dimensions of adaptive expertise among university teachers. Therefore, possible reasons for this observation was discussed with suggestions for improvement of the tool and future studies. The positive correlations of adaptive expertise with perceived work performance and academic ranking indicates the importance of developing adaptive expertise among university teachers.

CHAPTER 1

1. Problem Statement

The ability of people who can work successfully and efficiently in non-standard situations can be called adaptive expertise. Organisations and institutions need to assess and develop this capacity among their employees to face the uncertainties in the world. A recent example is COVID-19 pandemic, and it caused a considerable change to the academic environment. This highlights the importance of developing adaptive expertise among university teachers. Previous research pointed out the value of exploration of adaptive expertise in non-standard situations such as the COVID-19 pandemic. The present study aimed to investigate dimensions of adaptive expertise of a group of university teachers and its relationships with perceived work performance, work experience and academic ranking in this altered academic environment.

Today's work environments are characterised by an increase complexity due to higher levels of required knowledge and task volatility (Molloy & Noe, 2009). Besides, uncertainties are getting more common in every aspect of human life in today's world. Therefore, the success of individuals, organisations and communities is dependent on the ability to cope with these unexpected situations. And workers need to be increasingly adaptable, versatile, and tolerant of uncertainty. In short, people must be able to deal effectively with novel situations and problems. While some people quickly overcome changes in work requirements by inventing new procedures and using their expert knowledge in novel ways, others do not possess this ability and find themselves thrown back, performing as a novice (Hatano & Inagaki,1986; Holyoak, 1991). This ability to quickly get accustomed to change has been called "Adaptive Expertise" (Hatano & Inagaki, 1986). Other definitions of adaptive expertise refer to ''coping with change", ''dealing with uncertain situations", 'transfer learning as job demands vary'',

or ‘‘transfer expertise to novel problems’’(Carbonell, Stalmeijer, Könings, Segers, & Van Merriënboer 2014).

Research studies conducted among various professions and domains have highlighted the importance of preparing workers for non-standard conditions. Therefore, continually changing, and complex situations, and the learning in working life, require adaptive expertise (Siklander & Impio, 2019). The changes to work and the increasing proliferation of new knowledge and tools present challenges to individuals in the form of unfamiliar situations (Carbonell & van Merrienboer, 2019). This challenge is surmountable if individuals are stimulated to develop adaptive expertise in formal instructional settings, and their natural work environment (Carbonell & van Merrienboer, 2019). Accordingly, adaptive expertise is an attractive and an essential attribute for all professions acquire to face challenges in the changing world today. As such, the development of adaptive expertise should be considered as an important element in the professional development programmes. Therefore, research on the exploration of adaptive expertise in different professions should be worthwhile for the success of training and development of adaptive expertise among workers.

Teaching in complex situations often demand new insights. With the ongoing pandemic of COVID-19, almost all the universities and schools in affected countries had to shift to alternative modes of teaching and learning which are quite challenging for many teachers in the universities and schools. Although advanced technology is being used in many universities currently, still the most teaching is based on the traditional model unless the programme is delivered in a distance learning or an online mode. When face to face teaching sessions are shifted to an online mode, it needs additional preparations, technological skill, and creativity, which could be quite challenging for most of the teachers. It is more challenging if teachers lack an awareness of how they can exploit their routines from adaptive perspectives (Mannikko & Husu 2019). Therefore, readiness and acceptance of the challenge by the university teachers play a crucial role in the success of compensatory mechanisms in regaining of the sound teaching programmes.

Teachers with greater adaptive expertise can create more workable ideas and implement innovative teaching approaches than teachers with lower adaptive

expertise (Fairbanks et al., 2010; Robertson & Richards, 2017; Mannikko & Husu 2019). Mannikko & Husu 2019 reported that teachers with a high level of adaptive expertise could benefit from their routines and develop them further in order to better concentrate on the situation and its demands, based on a study conducted among primary schoolteachers. Further, they indicated that highly adaptive teachers attempted to build more analytical and creative adaptations indicating the importance of adaptive expertise among teachers.

Although there are several studies carried out on adaptive expertise among schoolteachers, no formal reported studies are found in the context of adaptive expertise of among university teachers. Furthermore, Carbonell, Könings, Segers & van Merriënboer (2016) pointed out that the traditional adaptive expertise research plays a lesser role compared to the need for non-standard but realistic tasks that elicit the problem-solving skills of individuals with adaptive expertise. Therefore, the present study aimed to explore the adaptive expertise of university teachers with due consideration to the ongoing pandemic health crisis, which has created an altered academic environment (non-standard) in the university teaching programmes. The aim of the study was to investigate dimensions of adaptive expertise of a group of university teachers and how these dimensions influence perceived work performance in this altered academic environment. Further, the study aimed to see whether there were any relationships of adaptive expertise with the academic ranking of university teachers and their work experience.

CHAPTER 2

2. Theoretical Framework

This chapter gives a comprehensive description of adaptive expertise, including its dimensions and measurement procedures. Research question, hypotheses and the model were further elaborated. Generally, three dimensions (Domain, Metacognitive and Innovative skills) have been described for adaptive expertise. Scholars have identified the ability to finish task productively when confronted with novel situations as a key difference between routine and adaptive experts. Further, the adaptive expert has an extensive and integrated knowledge base with a deep understanding of the relevance of knowledge compared to the static knowledge of routine experts (Hatano & Inagaki, 1986).

Objective and subjective measures can assess adaptive expertise. Objective measures use challenging tasks within the subject domains in real or virtual situations, while subjective measures rely on individuals' perception of their behaviour.

2.1 What is Adaptive Expertise?

Expertise is defined as the competence in the cognitive and/or psychomotor skills central to accomplishing performance goals across a range of applied domains (Matthews, Wohleber, & Lin, 2019). Expertise has defining characteristics that go beyond intelligence or ability (Lajoie & Gube, 2018). Expertise reflects increasing competence as the person transitions from the early cognitive stage to well-practised autonomous skill execution through practice (Matthews et al., 2019). Expertise falls into two categories: routine and adaptive. Routine expertise enables experts to exhibit speed and accuracy in solving any problem that falls into well-established patterns previously experienced (Bowersa, Merritt & Rimm-Kaufman, 2019). Adaptive expertise enables experts to respond to novel situations more effectively and innovatively than routine experts (Schwartz, Bransford, & Searset, 2005). In other words, individuals with adaptive expertise can face novel and challenging situations with success irrespective of unfamiliarity of the circumstance. As adaptive expertise is

mostly discussed in relation to work performance, there are some other terms used by researchers when describing the dimensions and concepts of adaptive expertise namely, adaptive performance (Pulakos, Arad, Donovan, & Plamondon, 2000), professional expertise (Johanna & van der Heijden, 2000), and adaptable behaviours (Griffin & Hesketh, 2003).

2.2 Difference between Adaptive Expertise and Routine Expertise

Hatano and Inagaki (1986) first coined the term “adaptive expertise” and contrasted it with routine expertise. They stated that the key difference between adaptive experts and routine experts was their ability to work productively when confronted with novel situations. Adaptive experts adapt and overcome uncertainty by displaying high levels of performance, while routine experts struggled with novel problems (Schwartz et al., 2005). They conceptualise that both types of expertise comprise the same extent of domain knowledge and the ability to perform flawlessly in familiar situations. However, the difference becomes apparent once confronted with an unfamiliar circumstance: a situation in which the task, method or desired results are not known in advance (Ellström, 2001). Then rules or procedural knowledge (know-how) are not available from previous experience. In such situations, an adaptive expert engages in a more active process of knowledge-based problem solving through experimentation (Hatano and Inagaki,1986). In other words, person has to invent and test a solution to the given problem based on knowledge about the task and about possible alternative solutions (Hutton et al., 2017). This shows that adaptive experts have to be aware of the principles behind the procedures they are executing – they possess not only the “know what” and the “know how”, but also the “know why” (Nikolowa, 2013). As a result, adaptive experts can solve novel problems and even invent new procedures (Nikolowa, 2013). Eva (2005) also has reported that the organization and coordination of that knowledge are more important than the quantity for expert performance.

Adaptive experts are willing to engage in active experimentation which creates a greater possibility to acquire deep conceptual knowledge (Hakano & Inagaki 1986). In contrast, routine experts lack a deep conceptual understanding of both the domain and the guiding principles needed to accomplish a task. Adaptive experts are much more likely to change their core competences and expand and restructure their

expertise, whereas core competences of routine experts develop throughout their lives with growing efficiency (van Tartwijk, Zwart, & Wubbels, 2017). Therefore, adaptive expertise is characterised by efficiency and innovation in applying the knowledge to new situations and challenges (Bransford, Brown, & Cocking, 2005; Hutton et al., 2017) in contrast to routine expertise.

Bransford et al. (2000) delineate routine experts as “artisans” and adaptive experts as “virtuosos”. According to Bransford et al. (2000), artisans continue to work within their boundaries while virtuosos seek opportunities to broaden their knowledge. Some researchers (Carbonell et al., 2014; Hatano & Inagaki, 1986) believe that adaptive expertise develops from routine expertise as individuals continue to develop domain-specific skills. Generally, expertise becomes automated or routine, requiring less cognitive resources after it is learned. However, the “virtuoso” may make a conscious effort to avoid such automation by continual use and extension of their knowledge (Ericsson 2006). Sawyer (2006) has reported that specific brain patterns necessary for the creative production of ideas are activated when acquired expert knowledge is flexibly and playfully linked with the current environment based on the evidence from neuroscience research. This implies that adaptive experts are able to transform their current knowledge and methods and adapt to novel situations to solve non-standard problems successfully (Carbonell et al., 2016). In summary, it can be stated that key differences between routine expertise and adaptive expertise are evident in the knowledge representation (organization), problem solving approach through knowledge-based experimentation, knowledge seeking behaviour and ability of being successful in non-standard (novel) situations.

2.3 Dimensions or Framework of Adaptive Expertise

Although the general definition of adaptive expertise is agreed to a considerable degree among researchers, there are diverse opinions about dimensions or framework of adaptive expertise. It seems that adaptive expertise is a multi-faceted construct that encompasses a range of dimensions as revealed by different authors. Table 1 shows a compilation of these dimensions described under different descriptions of adaptive expertise. Therefore, there is no single universally accepted framework that could be used for any profession in any circumstances.

Table 1

Summary of Dimensions of Adaptive Expertise

Number of dimensions	Defined terms	Names of dimensions	References
Eight	Adaptive performance	1. Handling emergencies or crisis situations 2. Handling work stress 3. Solving problems creatively 4. Dealing with uncertain and unpredictable work situations 5. Learning work tasks, technologies & procedures 6. Demonstrating interpersonal adaptability 7. Demonstrating cultural adaptability 8. Demonstrating physically oriented adaptability	(Pulakos et al., 2000).
Five	Professional expertise	1. Knowledge 2. Meta-cognition 3. Skills 4. Social recognition 5. Growth and flexibility	(Johanna & van der Heijden, 2000).
Three	Adaptable behaviour	1. Proactive (creative problem solving, dealing with crises) 2. Reactive (new learning, intepersonal, cultural and physical adaptability) 3. Tolerant (coping with stress, coping with uncertainty	(Griffin & Hesketh, 2003).
Four	Adaptive expertise	1. Multiple perspectives 2. Metacognition 3. Goals and beliefs 4. Epistemology	(Fisher & Peterson, 2001).
Three	Adaptive expertise	1. Domain skill 2. Metacognitive skill 3. Innovative skill	(Carbonell et al., 2016; Crawford, Schlager, Toyama, Riel & Vahey,2005; Hatano & Inagaki, 1986; Hatano & Oura, 2003)

Pulakos et al. (2000) defined eight different dimensions of adaptive performance, the visible behaviour of adaptive expertise based on a study of critical incidents in various jobs. These eight dimensions are shown in the Table 1 and

detailed definitions of dimensions are given in the Table 2 (Pulakos et al., 2000). Griffin and Hesketh (2003) proposed that the dimensions of adaptive performance identified by Pulakos et al. (2000) could be categorised into proactive (creative problem solving, dealing with crises), reactive (new learning, inter-personal, cultural and physical adaptability) and tolerant (coping with stress, coping with uncertainty). Reactive behaviours allow individuals to change, be flexible, and improve in order to adapt to their environments (Griffin & Hesketh, 2003). Reactive behaviours are an important component where expert individuals can take multiple perspectives and come up with alternative solutions in adapting to new environments (Griffin & Hesketh, 2003; Hatano & Oura, 2003). Proactive behaviours are defined as taking the initiative in improving current situations or creating alternative solutions (Crant, 2000). This often occurs during the process of experts seeking to adapt to new environments (Griffin & Hesketh, 2003).

Table 2

Definitions of Eight Dimensions of Adaptive Performance

Name of dimension	Definitions
Handling emergencies or crisis situations	Reacting with appropriate and proper urgency in life threatening, dangerous, or emergency situations; quickly analysing options for dealing with danger or crises and their implications; making split-second decisions based on clear and focused thinking; maintaining emotional control and objectivity while keeping focused on the situation at hand; stepping up to take action and handle danger or emergencies as necessary and appropriate.
Handling work stress	Remaining composed and cool when faced with difficult circumstances or a highly demanding workload or schedule; not overreacting to unexpected news or situations; managing frustration well by directing effort to constructive solutions rather than blaming others; demonstrating resilience and the highest levels of professionalism in stressful circumstances; acting as a calming and settling influence to whom others look for guidance.
Solving problems creatively	Employing unique types of analyses and generating new, innovative ideas in complex areas; turning problems upside-down and inside-out to find fresh, new approaches; integrating seemingly unrelated information and developing creative solutions; entertaining wide-ranging possibilities others may miss, thinking outside the given parameters to see if there is a more effective approach; developing innovative methods of obtaining or using resources when insufficient resources are available to do the job.
Dealing with uncertain and unpredictable work situations	Taking effective action when necessary without having to know the total picture or have all the facts at hand; readily and easily changing gears in response to unpredictable or unexpected events and circumstances; effectively adjusting plans, goals, actions, or priorities to deal with changing situations; imposing structure for self and others that provide as much focus as possible in dynamic situations; not needing things to be black and white; refusing to be paralyzed by uncertainty or ambiguity.

Learning work tasks, technologies, and procedures	Demonstrating enthusiasm for learning new approaches and technologies for conducting work; doing what is necessary to keep knowledge and skills current; quickly and proficiently learning new methods or how to perform previously unlearned tasks; adjusting to new work processes and procedures; anticipating changes in the work demands and searching for and participating in assignments or training that will prepare self for these changes; taking action to improve work performance deficiencies.
Demonstrating Inter-personal adaptability	Being flexible and open-minded when dealing with others; listening to and considering others' viewpoints and opinions and altering own opinion when it is appropriate to do so; being open and accepting of negative or developmental feedback regarding work; working well and developing effective relationships with highly diverse personalities; demonstrating keen insight of others' behaviour and tailoring own behaviour to persuade, influence, or work more effectively with them.
Demonstrating cultural adaptability	Taking action to learn about and understand the climate, orientation, needs, and values of other groups, organizations, or cultures; integrating well into and being comfortable with different values, customs, and cultures; willingly adjusting behaviour or appearance as necessary to comply with or show respect for others' values and customs; understanding the implications of one's actions and adjusting approach to maintain positive relationships with other groups, organizations, or cultures.
Demonstrating physically oriented adaptability	Adjusting to challenging environmental states such as extreme heat, humidity, cold, or dirtiness; frequently pushing self physically to complete strenuous or demanding tasks; adjusting weight and muscular strength or becoming proficient in performing physical tasks as necessary for the job.

Note. Source: Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000).

Fisher and Peterson (2001) have identified four main constructs (multiple perspectives, metacognition, goals and beliefs, and epistemology) which form the foundation of adaptive expertise using a survey tool among three engineering populations (freshmen, senior students, and faculty staff). As explained by the authors, i) multiple perspectives refers to the willingness of students to use a variety of representations and approaches when working within the domain; ii) metacognition refers to the learners' use of various techniques to self-assess and monitor his/her personal understanding and performance; iii) goals and beliefs describe the views that students have concerning their learning and iv) epistemology refers to how individuals perceive the nature of knowledge as an evolving entity rather than a static destination and realise the need to continually pursue knowledge (Fisher & Peterson, 2001).

According to the newest literature, scholars have extracted three main dimensions of adaptive expertise: domain-specific skills, metacognitive skills, and innovative skills (Crawford, Schlager, Toyama, Riel & Vahey, 2005; Hatano & Inagaki, 1986; Hatano & Oura, 2003; Männikkö & Husu, 2019; Mees, Sinfield, Collins & Collins, 2020). Some researchers indicated that although domain-specific and metacognitive skills are shared between adaptive and routine expertise (Carbonell et al., 2016; Feltovich, Prietula & Ericsson, 2006), the level of metacognition did not help to distinguish between routine expertise and adaptive expertise (Carbonell et al., 2014). Carbonell et al. (2016) stated that metacognitive capacity may not be a measure of adaptive expertise and developed an inventory to assess it by measuring an individual's domain skills and innovation skills. However, metacognitive skill has been conceptualised by some scholars as a defining characteristic of adaptive expertise (Feltovich, Prietula, & Ericsson, 2006). Two recent studies have indicated that teachers can develop more adaptive expertise for practical actions by using metacognitive approach based on studies conducted among teachers (Männikkö & Husu, 2019) and outdoor instructors (Mees, et.al, 2020). They reported that adaptive expertise is developed through the processes of reflection and conscious deliberation in which practical knowledge is theorised, and theoretical knowledge is interpreted in practice. As the nature of occupation of schoolteachers and instructors have a similarity to that of the university teachers, the current study considered the dimensions of domain-specific skills, metacognitive skills, and innovative skills to investigate the adaptive expertise of the present sample of university teachers.

2.3.1 Domain Specific Skills

Domain knowledge refers to declarative knowledge (knowing that), procedural knowledge (knowing how) and conditional knowledge (knowing when and where) individuals need to possess it to perform in a specific domain (Alexander, 1992). Experts and novices have different knowledge representation in the extent, organisation, abstraction, and consolidation, information retrieval and therefore problem-solving could be varied between the two groups (Chi, 2006; Carbonell et al., 2014; Schwartz et al., 2005). The adaptive and routine experts have a similar extent of knowledge, but the knowledge of adaptive experts seems to be more abstract (Carbonell et al., 2014). They highlighted that the manner in which the body of knowledge is organised plays a greater role in adaptive expertise. Further, the knowledge representation, in terms of organisation, abstraction, and consolidation, is independent of the context of the situation (de-contextualisation) (Carbonell et al., 2014). In other words, knowledge representation of adaptive experts is weakening the link between a situation and its solution. Thus, it is easier for individuals to apply a known solution to a new situation (Carbonell et al., 2014). Accordingly, contextual knowledge has a lesser impact on adaptive expertise than declarative knowledge and its organisation. In other words, adaptive expertise results in organisation of knowledge, which makes it easy to be applied to various situations (Carbonell et al., 2014).

Adaptive experts also seem to have cognitive flexibility and more problem-solving skills than routine experts (van Tartwijk et al., 2017). Cognitive flexibility refers to the ability to switch between thinking about two different concepts or to think about multiple concepts simultaneously (Magnusson, & Brim 2014). Chi (2016) pointed out that experts learn, reason, and remember laboratory methods by reviewing several concepts with the goal of understanding the theory and solving problems by a review analysis of experts' and novices' knowledge of laboratory study methods. Therefore, adaptive experts rely more on analogical reasoning in which they use their organised knowledge base in problem-solving.

2.3.2 Metacognitive Skills

In simple terms, metacognition refers to “thinking about thinking” or our ability to know what we know and what we do not know (Costa & Kallick, 2009; Livingston, 1997). Individuals with good metacognitive skills are able to plan an approach to learn a new skill or solve a problem, monitor their progress towards their goal, and evaluate their success (Livingston, 1997). Further, they can analyse both the requirements of the task and their Knowledge base and skills. Also, they can decide on an effective approach and determine what else they need to learn to be successful (Livingston, 1997). Therefore, metacognition helps to plan a strategy for producing the information that is needed, to be conscious of the steps and strategies during the act of problem solving, and to reflect on the productiveness of the thinking (Costa & Kallick, 2009; Livingston, 1997). It can be stated that these attributes could relate to the characteristics of adaptive expertise.

People with high adaptive expertise demonstrate a good capacity to self-assess their expertise, knowledge, learning, and problem-solving ability (Bell, Kozlowskil, 2008; Crawford et al., 2005). These skills enable individuals to view situations in new contexts and create analogies, thus making adaptability transferable and transportable to new contexts (Mees et al., 2020). Furthermore, they pointed out that adaptive expertise may entail viewing components as ingredients that can be reassembled differently to deal with novel situations (Mees et al., 2020). Gube & Lajoie (2020) has reported that metacognition play an important role when searching and inventing new solutions or development of new alternatives.

However, Carbonell et al. (2016) argued that the exact role of metacognitive skills is not clear in the development of adaptive expertise. Results of a study which validated a tool to measure adaptive expertise using a sample of eleven various professional groups (196) and university graduates (216) with different geographical backgrounds showed that metacognitive skills are not a defining characteristic of individuals with adaptive expertise (Carbonell et al., 2016). Further, they stated that metacognitive skills can be part of a tool that measures adaptive expertise, but this is not imperative (Carbonell et al., 2016). Therefore, there is uncertainty about the significance of metacognitive skills in the concept of adaptive expertise.

2.3.3 Innovative Skills

Some conceptual framework of adaptive expertise defines problem-solving skill along the dimensions of efficiency and innovation (Bransford et al., 2005; De Arment, Reed & Wetzel, 2013; Schwartz, et al., 2005). Developing expertise on the efficiency dimension implies developing routines or in other words “performing particular task without having to devote too many attentional resources to achieve them”. Developing expertise on the innovation dimension typically involves moving beyond existing routines and often requires people to rethink key ideas, practices, and even values in order to change what they are doing (Schwartz et al., 2005; van Tartwijk et al., 2017).

Schwartz et al. (2005) have depicted adaptive expertise as the relationship between dimensions of efficiency and innovation. The efficiency is individual’s competency to apply domain knowledge and skills fluently to complete activities about which he or she has significant experience (McKenna, 2014). Therefore, the Individuals’ ability increases with accuracy and speed on the task when the person gains more experience. The innovation involves developing a solution to a new situation where one does not yet exist (McKenna, 2014). Therefore, one has to recognize how prior knowledge might apply under new circumstances. Further, it suggests that the nature of knowledge one employs in the innovation process is nuanced and complex (McKenna, 2014). Also, the new knowledge can improve on old ideas or identify completely new directions for approaching a new solution (McKenna, 2014). Therefore, new knowledge built on a challenging situation and an inquiring mind with the self-regulating skills of adaptive experts are used to identify and comprehend a problem, identify what additional knowledge is necessary, and to generate ideas and leverage existing knowledge to facilitate recognition of relevant information (McKenna, 2014).

Accordingly, adaptive expert is equally high in both dimensions; innovation and efficiency (Schwartz, et al., 2005) (Figure 1). In contrast, a routine expert demonstrates a high degree of efficiency but low innovation (Figure 1). Therefore, the route to adaptive expertise as described by Schwartz, et al. (2005) is balancing between development along both dimensions. In other words, adaptive expertise is when

experts are both efficient and innovative. As shown in Figure 1, Schwartz et al. (2005) described that the function of optimal adaptability corridor was to ensure that the innovation and efficiency developed together. Also, it serves as a framework for gauging or developing instructional strategies for educators (McKenna, 2014).

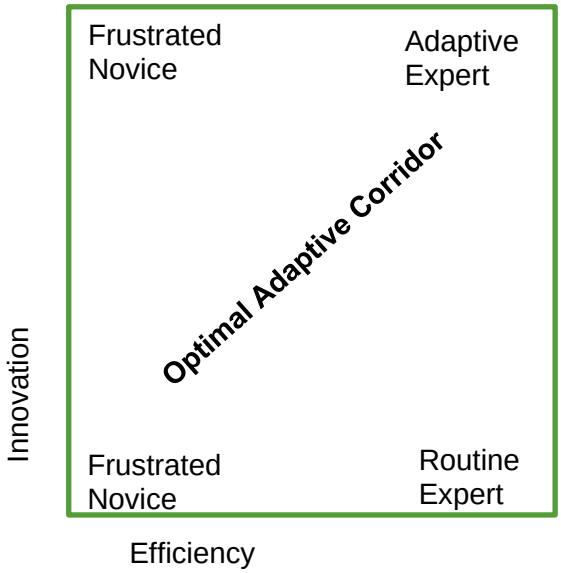

Figure 1. Balancing efficiency and innovation in learning. source Schwartz, D. L., Bransford, J. D., & Sears, D. (2005)

Hatano and Inagaki (1986) explained that routine expertise is beneficial in stable environments with predictable challenges while adaptive expertise allows individuals to effectively respond to a variable environment by adapting and innovating to changing situations. Moreover, individuals with high adaptive expertise display creative problem-solving abilities and innovativeness effectively in dealing with novel and uncertain situations (Pulakos et al., 2000; Schwartz et al., 2005). In contrast routine experts continue improving task efficiency (Schwartz et al., 2005). Compiling several research data from the literature, Gube, & Lajoie, (2020) stated that speedy recall (routine) of foundational domain knowledge is the efficiency, and it makes the basis of innovation in a domain. So adaptive experts respond to new situations innovatively using their domain content knowledge. Thereby adaptive experts draw on additional cognitive and metacognitive skills to move beyond routine expertise and create new knowledge through their responses (Gube & Lajoie, 2020). Further citing from the literature, they reported that these distinctions could be captured from the frequently used definitions of adaptive expertise; “Whereas routine experts are able to solve familiar types of problems quickly and accurately, they have only modest

capabilities in dealing with novel types of problems. Adaptive experts, on the other hand, may be able to invent new procedures derived from their expert knowledge." (Holyoak,1991).

From the stream of information explained above, it is reasonable to assume that there is no concrete agreement yet on the dimensionality of the constructs of adaptive expertise although it has been unanimously accepted as an essential attribute in every profession. Moreover, adaptive expertise is more important today than ever before as it helps the success of individuals' work performance in the unpredictably complex situations which are getting commoner now.

2.4 Perceived Work Performance, Academic Ranking and Adaptive Expertise

Organisational success is significantly contributed by employees who have skills to accommodate changes in the work environment and adapt to changing situations (Pulakos, et al., 2000). As described previously (sections 2.2.and 2.3) adaptive experts face new challenges and learn constantly and create new problem-solving strategies during their work activities. Thus, it could be expected that adaptive experts can show a good work performance even in uncertain situations like COVID-19 since they have a greater capability of dealing with novel conditions with efficiency and innovativeness.

2.4.1 Perceived Work Performance

Like adaptive expertise, work performance is a multi-dimensional concept, and it has been described under three forms: Task performance, Contextual performance and Adaptive performance (Sonnentag, Volmer, & Spychala, 2008). Further, Sonnentag et al. (2008) described the three types of work performance as given below:

> **Task performance**: It covers a person's contribution to actions that are part of the formal reward system (i.e., technical core), and addresses the requirements as specified in job descriptions. Thus, task performance covers the fulfillment of the requirements that are part of the contract between the employer and the employee.

Contextual performance: Contextual performance consists of behaviour that does not directly contribute to organisational performance but supports the organisational, social and psychological environment. Contextual performance is different from task performance as it includes activities that are not formally part of the job description. It indirectly contributes to an organisation's performance by facilitating task performance. Examples are demonstrating extra effort, following organisational rules and policies, helping and cooperating with others, or alerting colleagues about work-related problems.

Adaptive performance: This refers to the extent of adaptation to changes at the workplace (Griffin, Neal, & Parker, 2007). Sonnentag et al. (2008) used the eight-dimensional taxonomy of adaptive performance described by Pulakos et al. (2000) (details in section 2.3 and Table 2) to explain adaptive performance.

In the context of university teachers, they have different duties which include teaching, research and administration in addition to social responsibilities as academics. Therefore, three forms of work performance are seen among university lectures. Empirical evidence has suggested that performance is a dynamic construct, and that performance fluctuates within individuals and changes over time (Kim & Lee, 2010; Sonnentag et al., 2008). Furthermore, they reported that individuals differ in their performance trajectories, with some individuals increasing their performance at a faster rate than others. The best performers at a given point in time might not be the best performers five or ten years later (Sonnentag et al., 2008).

However, work performance is not only influenced by person-specific attributes but also by characteristics of the situation in which the performance occurs (Bhat &Beri, 2016). Research on situational antecedents of job performance addresses workplace factors (work climate factors) that enhance as well as potentially hinder performance (Sonnentag, et al., 2008). Kim & Lee (2010) reported that perceived legal accountability requirements, excessive pressure for compliance accountability and political accountability could adversely affect perceived job tension which in turn influences the employees' perceived work performance. Also, the perceived high workload and concurrent job tension among employees could negatively affect their perceptions of work performance. (Kim & Lee, 2010).

With the closure of universities due to COVID-19 pandemic, teaching sessions have been shifted from face-to-face methods in the lecture halls to online. University teachers had to shift their teaching mode into e-learning and virtual meetings and do the job from their residence (“work at home”). However, they had to ensure that the goals of the sessions were fulfilled without compromising the quality. Furthermore, university teachers had to adapt to the new situation (“new normal”) within a short period of time. This led to change in the work climate factors and gave rise to situational constraints which have been reported as having a negative impact on job performance (Bacharach & Bamberger, 1995; Bhat & Beri, 2016). Situational constraints refer to problems with machines, technology, incomplete materials or lack of necessary information (Sonnentag et al., 2008). Besides, in general, the pandemic situation has caused mental stress among people due to the fear for their health and others, feeling of insecurity and limited social interactions. It has been already reported that the COVID-19 pandemic and the rapid and comprehensive shift in the academic environment are closely related to teachers' stress levels in applying online teaching methods based on a study conducted among 228 university teachers in Indonesia (Christian, Purwanto, & Wibowo, 2020).

As explained previously, individuals with adaptive expertise are adaptable, versatile, and tolerant of uncertainties such as the COVID-19 pandemic. However, these occasions are more challenging if teachers lack an awareness of how they can exploit their routines from adaptive perspectives (Mannikko & Husu 2019). In contrast, teachers with adaptive expertise should be able to use their problem-solving skills and make innovative solutions to overcome the challenges that occurred in the non-standard situation. Accordingly, it could be speculated that work performance of university teachers with adaptive expertise remains unchanged despite the changes in the work climate due to the pandemic of COVID-19.

2.4.2 Academic Ranking

Unlike in schools, a distinct academic ranking system is seen among the academic staff of universities globally. The commonly used standard system is lecturer, senior lecturer, assistant professor, associate professor and full professor in ascending order of the ladder. Several researches have shown that certain parameters like research output (bibliometric measures) (Gunawan, 2020; Susarla,

Dhar, Karimbux, Tinanoff, 2015) job satisfaction and academic productivity (Bashir, Jianqiao, Zhao, Ghazanfar, & Khan, 2011) vary in relation to academic ranking. A positive relationship was recorded between academic ranking and the output of scientific publications using different indexes such as SINTA (Science and Technology Index, Indonesia) and h-index (Gunawan, 2020; Susarla, et al., 2016). They showed a positive coefficient correlation between academic rank and h- index, meaning that the higher the academic ranking, the higher the performance of the publication. Bashir et al. (2011) reported that job satisfaction and performance were higher among university teachers with higher rank than the remaining ones by analysing a system called HPWS (High Performance Work System). HPWS is implemented in some organisations and institutions to enhance work performance, productivity and employees' job satisfaction (Huselid, 1995).

In summary, it appears that the academic productivity and work performance are higher among faculty members with higher ranks than those with lower ranks. Therefore, it is sensible to expect a positive relationship of adaptive expertise with academic ranking and work performance. To my knowledge, there are no reported studies which measured the adaptive expertise of university teachers although some studies are available on work performance. This emphasises the need for an assessment of adaptive expertise and work performance among university teachers by further investigation.

2.5 Measurement of Adaptive Expertise and Perceived Work Performance

2.5.1 Assessment of Adaptive Expertise

Adaptive expertise is complex and multi-componential, and therefore its measurement is complex. Methods for assessing adaptive expertise can be categorised into objective and subjective measures. Objective measures focus on assessing the mental models and cognitive strategies of individuals (Carbonell & van Merrienboer, 2019). When measuring adaptive expertise objectively, it is necessary to identify a challenging task that is representative of the domain. Indicators of adaptive expertise are the accuracy of the solution, time taken to answer, degree of elaboration, number of relevant concepts mentioned, and so forth (Carbonell & van Merrienboer, 2019). These are tasks that routine and adaptive experts should accomplish with the same

level of performance (e.g. same speed and accuracy), whereas novices should not be able to complete the task due to unfamiliarity of the situation. An example from my own profession is the extraction of a wisdom tooth (third molar) with an anatomical abnormality affecting its roots. There is a standard technique for the extraction of a wisdom tooth, but it can become complicated when the abnormal (tooth) roots are very close to the nearby nerve (mandibular nerve). In such situations, use of the standard technique would result in a disastrous outcome for the patient. Therefore, a modified technique is necessary to avoid the nerve damage during the tooth extraction. The experience of the surgeon is mostly helpful in deciding when to use a modified technique when presented with a similar situation.

As experience provides a learning opportunity to individuals by observing how the variation of actions impact outcome (Hatano & Inagaki, 1986), this should be considered during assessment of performance during an objective measurement of adaptive expertise (Carbonell & van Merrienboer, 2019). Therefore, designing unfamiliar tasks becomes increasingly more difficult with the increasing level of domain expertise due to a large amount of experiences domain experts have accumulated. In this context, measurement of adaptive expertise objectively might be better suited for novices and intermediates than for experts (Carbonell & van Merrienboer, 2019).

Subjective assessment of adaptive expertise relies on individuals' perception of their behaviour. Various subjective measuring tools exist that measure an individual's ability to adapt to changes. A few inventories have been developed in the past using the components/dimensions of adaptive expertise described in section (2.3). First, Pulakos et al. (2000) developed a tool that evaluated adaptive performance. Adaptive performance is the effort of an individual to realign his or her behaviour with new demands at the workplace (Chan, 2000). Eight dimensions (Table 1) of adaptive expertise (measured concept is "adaptive performance") described by Pulakos et al. (2000) was assessed using the Job Adaptability Inventory (JAI) which consisted of 190 items including items referring to the workplace. The Inventory was validated using exploratory and confirmatory factor analyses, and the number of total items was reduced to 132 and 15 -18 items were included per dimension. Carbonell et al. (2016) reported after its in-depth analysis that although Job Adaptability

Inventory of Pulakos et al. (2000) contained sub-scale items for domain and innovative skills, there were no items for metacognitive skills.

The tool developed by Johanna & van der Heijden (2000) was to measure professional expertise (expert performance) and related all items to the participant's work environment. The authors perceived that meeting and even exceeding achievement standards is of utmost importance to experts. This tool (Johanna, & van der Heijden, 2000) addressed the dimension of expertise mostly relevant to the workplace, and they included sub-scale items for all five dimensions (Table 1) including domain, metacognitive and innovative skills; (Knowledge = 17, Metacognition = 15, Skill requirement = 12, Social recognition = 15, Growth & flexibility = 19). They observed oblique representation in the factor structure instead of the orthogonal and concluded that although five dimensions are not fully mutually exclusive, they represent correlated aspects of professional expertise.

Fisher and Peterson (2001) developed a tool to measure attitudes towards adaptive expertise among engineering students. At face value, this tool seemed to measure adaptive expertise (Carbonell et al., 2016). The conceptual framework they focused was on "adaptiveness" and not on expert performance. This position resulted in a tool that measured "disposition or mindset" (Fisher & Peterson, 2001) when solving problems and therefore neglected the level of domain-specific skills necessary to be called an expert (Carbonell et al., 2016). The tool developed by Fisher and Peterson (2001) included 42 items (Extracted from 49 items) to measure four dimensions (Table 1) including metacognitive and innovative skills but not for domain skill.

Carbonell et al. (2016) selected the tools developed by Fisher and Peterson (2001) and Johanna, & van der Heijden (2000) assuming that these two tools provided the closest fit to the concept of adaptive expertise and used them to serve as a basis during development of the17-item tool which was used in the present study. A total of 41 items were included at the beginning and they were grouped into domain-specific skills, metacognitive skills, and innovative skills after having referred to the epistemological perspectives, workplace, and novel situations. The final tool consisted of 17 items: 5 items tapping into the domain-skills, 4 items measuring metacognitive skills, and 8 items capturing innovative skills. Finally, they refined the tool with only

two dimensions: domain-specific skills and innovative skills with five items each after performing the model fit statistics. Further, they postulated that metacognitive skills were a critical dimension of adaptive expertise. However, this could not be confirmed by their study involving 196 professionals and 216 university graduates (Carbonell et al., 2016).

The current body of research on adaptive expertise indicates that progress is needed with respect to validating the existing measuring tools further. This applies to both objective and subjective methods for measuring adaptive expertise. Carbonell and van Merrienboer (2019) have highlighted that although several methods for measuring adaptive expertise subjectively exist, it is not clear how sensitive they are over time, and how good they are at predicting the criteria. Thus, testing and retesting of evaluation tools of adaptive expertise need to be established in different populations.

2.5.2 Assessment of perceived work performance

It has been suggested that both person-specific and situation-specific constructs should be included in the prediction of job performance (Bhat & Beri, 2016; Rabenu, Yaniv, & Elizur, 2017; Sonnentag et al., 2008). A variety of tools to measure job performance has been used over the past decades. For example, rating scales, tests of job knowledge, hands-on job samples, and archival records have been used to assess job performance (Sonnentag et al., 2008). From these measurement tools, performance ratings (e.g. peer ratings and supervisor ratings) are the most frequent way of measuring job performance (Rabenu, Yaniv, & Elizur, 2017; Sonnentag et al., 2008). For example, sample questions which were used for assessment of work performance are shown below in the study of Rabenu et al. (2017) who studied relationship between psychological capital, coping with stress, well-being, and performance.

Question 1: How do you appraise your performance?

Question 2: In your opinion, how does your superior appraise your performance?

Question 3: In your opinion, how do your co-workers appraise your performance?

In addition, 'objective' criteria such as sales figures and production records were requested. However, even these criteria involve subjective judgments. Therefore, performance measures are still not perfect (Sonnentag et al., 2008).

2.6 Research Questions, Hypotheses, and the Research Model

As described in Section 1, development of adaptive expertise among university teachers is important for facing emerging challenges in the world such as the COVID-19 pandemic successfully. This highlights that research on the exploration of adaptive expertise among university teachers is a timely requirement. Although the literature has identified that adaptive expertise has three main dimensions: domain, metacognitive and innovative skills, this idea is not free from controversies (for details, see section 2.3). Therefore, before planning of development programmes on adaptive expertise, firstly it is imperative to identify its key dimensions among university teachers. Therefore, the first research question (RQ) and its sub-questions (SQ) are as follows:

RQ1: Which dimensions of adaptive expertise influence the adaptive expertise of university teachers?

SQ1b: Does the domain skill dimension influence the adaptive expertise of university teachers?

SQ1c: Does the metacognitive skill dimension influence the adaptive expertise of university teachers?

SQ1d: Does the innovative skill dimension influence the adaptive expertise of university teachers?

Carbonell et al. (2016) have reported that mainly the domain and the innovative skills dimensions influence adaptive expertise based on a validation study conducted

among several professionals. Some research studies have reported that metacognitive skill is necessary for the process of recognising and evaluating existing concepts (for details, see section 2.3). The above process is necessary for reconstructing new knowledge which is essential for designing innovative approaches during problem-solving in unfamiliar situations (Gunstone & Mitchell, 2005; McKenna, 2014). Moreover, two recent studies have indicated that teachers can develop more adaptive expertise for practical actions by using metacognitive approach based on studies conducted among teachers (Männikkö & Husu, 2019) and outdoor instructors (Mees, et.al, 2020). Therefore, the influence of metacognition on adaptive expertise cannot be overlooked or underestimated. Hence, it is expected that all three dimensions influence the adaptive expertise of university teachers. Therefore, the first hypothesis is as follows:

H1: The tool developed by Carbonell et al. (2016) to measure adaptive expertise can capture all three dimensions (domain, metacognitive and innovative skills) which would influence the adaptive expertise of university teachers.

The COVID-19 pandemic created non-standard situations in the working environment where university teachers had to perform routine duties in the altered academic milieu. The literature has evinced that adaptive experts are efficient and innovative in non-standard unfamiliar situations, as reported previously (See Section 2.2). Therefore, work performance is not affected significantly if university teachers possess better adaptive expertise. In contrast, teachers with less adaptive expertise could be handicapped severely affecting their work performance. Therefore, the second research question is as follows.

RQ2: What is the relationship between adaptive expertise and perceived work performance of university teachers in an altered academic environment due to COVID-19 pandemic?

If adaptive expertise of university teachers influences their work performance, the latter variable could vary depending on the level of adaptive expertise. Therefore, the second hypothesis is as follows:

H2: There is a positive correlation between adaptive expertise of university teachers and their perceived work performance.

Globally, university teachers have promotion schemes starting from the lower rank of lecturer to the highest rank of full professor. Generally, these promotion schemes are based on the achievements of teachers (e.g. teaching, research and innovations / patents) rather than on their seniority or work experience. Therefore, it is safe to state that high achieving university teachers ascend the promotion ladder faster. Furthermore, it has been reported that some measures of academic productivity correlate with the academic ranking of university teachers (Gunawan, 2020; Susarla, et al., 2016) (for more details, see section 2.4.2). Therefore, it is reasonable to speculate that some personnel qualities (characteristics) of university teachers influence their achievements. In this context, if these personnel qualities influence the adaptive expertise of university teachers, it is possible to see a relationship between adaptive expertise and academic ranking.

There are different opinions about an association between work experience and adaptive expertise. Some studies have reported that adaptive expertise was independent of the work experience (Carbonell, et al., 2016; Männikkö & Husu, 2019). An opposite opinion was recorded from a research study conducted among less experienced and more experienced outdoor instructors (Mees et al., 2020). Therefore, the third research question is as follows.

RQ3: What is the relationship between adaptive expertise and the academic ranks of university teachers and their work experience?

It can be assumed that knowledge and skills are accumulated by university teachers with their increasing academic experience. Knowledge and skills are important components of their expertise (For details, see sections 2.2 & 2.3). Furthermore, in my opinion, university teachers with higher academic rankings get more exposure to the academic environment than teachers in lower ranks and so acquire greater experience. Therefore, it is postulated that university teachers with higher academic rankings and more experience can demonstrate better adaptive expertise. So, the third and fourth hypotheses are as follows:

H3: There is a positive correlation between adaptive expertise and academic ranking of university teachers.

H4: There is a positive correlation between adaptive expertise and work experience of university teachers.

2.6.1 Research Model

Based on the latest information on measuring tools of adaptive expertise (Carbonell, & van Merrienboer, 2019), the following research model (Figure 2) was designed to investigate the research questions.

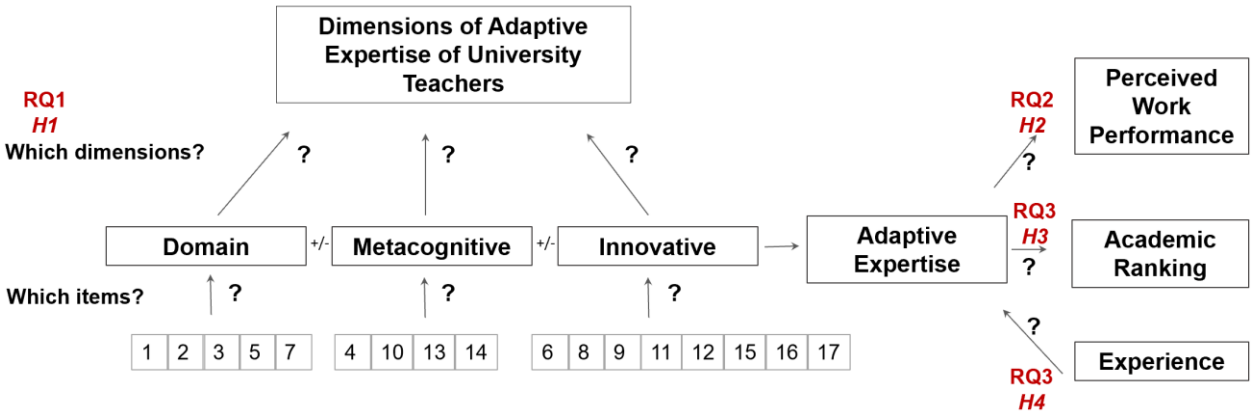

Figure 2. Research model designed for this study based on the tool developed by Carbonell et al. (2016).

CHAPTER 3

3. Methods

Data were collected using an online questionnaire which included 17 items of the adaptive expertise tool developed by Carbonell et al. (2016) and a few other questions about perceived work performance. In addition, demographic information was also collected. Descriptive statistics, EFA, CFA model fit indices and Spearman's Rank Correlation non-parametric test were selected for analysis of data.

3.1 Research Design

To explore the answers to the research questions, a descriptive cross-sectional study was carried out as this work investigated the subjective assessment (self-reported) of adaptive expertise of a previously uncharted population. Mainly quantitative data was collected from the demographic information and questionnaire responses of the participants using an online survey. The demographic information included age, sex, present and past work experiences, the field of expertise and present academic rank. Adaptive expertise tool developed by Carbonell et al. (2016) was used for measuring adaptive expertise of the participants. Three questions about the work performance, amount of work done, teaching quality and two other questions about the number of teaching sessions were added to measure perceived work performance.

3.2 Sample

The study population consisted of university teachers who are involved in the teaching component of study programmes. Education is one of the professions which is affected worse due to the COVID -19 pandemic as it evokes questions that cannot be answered with certainty about when this pandemic will end and academic work progresses within a safe learning environment in the universities. As a result, most of the universities including the university of Twente (UT) had to shift the teaching learning system into a fully online mode. Therefore, teachers had to adapt to the new situation of "work at home" and perform their routine duties via online platforms similar to what happened in several other organisations. It highlighted the importance of the need for adaptation ("adopt at work") to the new situation of delivering lectures and other modes of

teaching. As described in section 2, adaptive experts can work in an altered academic environment successfully in non-standard situations. Therefore, adaptive expertise is increasingly important than ever before, and it should be developed among university teachers to face unpredictably complex and dynamic work environments. Therefore, exploration of adaptive expertise among university teachers is warranted.

Considering the limitations imposed by the prevailing situation, the selected sample of the present study was made up of university teachers from Health Profession Education of the University of Twente (UT): Technical Medicine, Biomedical Engineering and Health Sciences. According to the registry, there were 123 teachers involved in the health education study programme of the UT. Among 123 eligible participants, 58 individuals consented to participate in the study via an online questionnaire giving a 47.15% response rate. However, only 40 individuals of the 58 completed the survey and the final response rate was 32.52%.

3.3 Tool (Instrument)

Self-reported study tool (Annexure I) was used for a subjective measure of adaptive expertise. It is a questionnaire containing 17 items developed by Carbonell et al. (2016) to measure adaptive expertise. Although both English and Dutch versions of the questionnaire are available, the English version was used in this study as there are both Dutch and Non-Dutch citizens working at the UT. These 17 items were developed to cover three dimensions (described in 2.3 and 2.4 sections; domain skills, metacognitive skills, and innovative skills) of adaptive expertise. The same tool had been already used in a few studies previously (Mees et al., 2020; Nikolowa, 2013).

Some items were modified slightly to suit the university environment and the teachers without changing the core meaning. The original items referred to a previous occasion, and therefore all statements started with the phrase “During the past projects”. Since the present study mainly addressed the current teaching environment, the above phrase was dropped. Table 3 shows the other modified items. The Likert scale responses of the original version ranged from 1 (strongly disagree) to 5 (strongly agree). In the present study, the responses were changed to “1: never or only rarely true of me, 2: sometimes true of me, 3: true of me about half the time, 4: frequently true of me, and 5: always or almost always true of me”.

The three questions about work performance, amount of work done, teaching quality and two other questions about the number of sessions which were not completed due to the altered academic environment were used to measure perceived work performance (Annexure 1). After designing the survey tool, it was pilot tested using two staff members of the Technical Medicine Department and some items were modified slightly to improve clarity and understanding. Demographic information of participants such as age, gender, academic rank, and experience was also collected to assess their influence on adaptive expertise and the representativeness of the sample.

Table 3

Modifications Made to the Original Items for Use in the Present Study

Item No	Original Item	Modified Items
Item 8	During past projects, I focused on new challenges	I focused on new challenges **in my academic environment**
Item 9	During past projects, I approached it like other projects I worked on in the past	I approached **new tasks/projects in similar ways as** I worked in the past.
Item 12	During past projects, I was able to apply my knowledge flexible to the different tasks within the project	I was able to apply my knowledge flexible to the different tasks **in my academic environment**
Item 13	During past projects, I was able to indicate when my knowledge is insufficient to perform a certain task or solve a particular problem.	I was able to **assess** when my knowledge is insufficient to perform a specific task or solve a particular problem
Item 16	During past projects, I was able to adapt my work habits to the needs of the project.	I was able to adapt my work habits to the needs of the **situation**

3.4 Procedure

Approval for the research project was obtained from the Ethical Review Committee of the Faculty of Behavioural Management Science (BMS) of UT by the principal investigator. The informed consent was requested from the participants in accordance with the BMS guidelines before proceeding to the survey link (questionnaire) on Qualtrics XM (USA). A statement “the data is treated confidentially and anonymised by the first investigator before presenting the data to the principal investigator and only aggregated data will be presented to the program directors” was included in the consent form.

The questionnaire was sent to all 123 teachers (academic staff) of the Health Education Study Programme of the UT using an e-mail directory obtained from the Faculty of Science and Technology UT. The duration of data collection was from 19/06/2020 to 17/07/2020. Data was collected anonymously and handled confidentially. Raw data containing personnel information and questionnaire responses were not communicated to anyone and, they were handled by the first investigator (research student). Data was exported to an Excel (Microsoft Office) file, and statistical analysis was done using IBM’s statistics programme SPSS (25th version) and R statistical package.

3.5 Data Analysis

The latent variables were adaptive expertise and its dimensions, and perceived work performance while observable variables were the responses to the questionnaire items. The tool of 17 items used in the present study has been tested and validated for some professions (Carbonell et al., 2016; Mees et al., 2020; Nikolowa, 2013) but not tested and validated for university teachers. Statisticians indicate that once an tool has been developed using Exploratory Factor Analysis (EFA) or other techniques, Confirmatory Factor Analysis (CFA) should be carried out to decide whether the tool (inventory) has the same structure across a certain population (Osborne, 2014 ; Wu & Jen, 2016). CFA enables the determination of how different the structure and function of a measurement tool across groups are (McGovern & Lowe 2018). In other words, CFA is conducted for the assessment of the factor structure produced by the EFA to fit the data (Osborne, 2014). Using CFA methods, we can examine whether a measure

is invariant across groups using fit indices (McGovern & Lowe 2018). Since the previous study (Carbonell et al., 2016) has extracted factors and identified the items of three dimensions using EFA and CFA, and the current study used the same measurement tool and factor structure, first CFA was performed to investigate whether the present data comply with the research model (Testing the first hypotheses). CFA was conducted using R statistic package to test the three dimensions of the factor structure shown in the research model (Figure 2) of adaptive expertise across the present study sample. However, differences were noticed about the level of significance of some items in the present study and those in the Cabonell's (2016) study. Therefore, EFA and CFA were repeated using the present data. Finally, the best fit model was selected using model fit indices, and the best model was chosen for further analysis namely the calculation of the scores for adaptive expertise and its dimensions and for correlation statistics (Testing the hypotheses 3-4). To select the best fit model, CFA was performed three times. In the first CFA, Likert scale data generated from all 17 items were included. In the second CFA, data from the items which contributed to the research model (Figure 2) with a statical significance was used (Items 1, 2, 3, 5, 6, 7, 8, 11, 13, 14). The third CFA was performed after performing ECA to the present data (Annexure 4).

The dependent variables were the scores of adaptive expertise and perceived work performance, whereas independent variables were age, gender, work experience and academic category (Rank). The responses of 17 items were scored (1 to 5), added and the mean values were calculated to create the adaptive score for each participant across the sample. Similarly, scores for the three dimensions were calculated. Perceived work performance was measured using the ratings scale (1 to 10) given for the three statements about work performance, amount of work done and teaching quality. The mean score of the three questions was taken to measure the perceived work performance. Respondents with no teaching involvement during the pandemic or incomplete data were excluded during the calculations. To investigate the relationship of adaptive expertise score with the perceived work performance, academic ranking and work experience, Spearman Rank Correlation non-parametric test was carried out. Spearman Rank Correlation was used to check all the correlations as it does not carry any assumptions about the distribution of the data and is the appropriate correlation analysis tool when the variables are measured on a

scale, i.e. for an ordinal/ranking data (Schober, Boer, & Schwarte, 2018). By using ranks, the coefficient quantifies monotonic relationships between two variables because ranking of the data converts a nonlinear monotonic relationship to a linear relationship (Schober et al., 2018).

The work experience was categorised according to the number of years of employment (less than a year, 1 to 5 years, 5 to 10 years, 10 to 15 years, and more than 20 years). Age was recorded in numbers. Academic ranks (positions) were ranked based on the ranking system generally used in the universities. However, the researcher category was excluded when analysing the relationship between the academic rankings and the scores for adaptive expertise due to a low representation of them (1 or 2) in the sample and inadequate details of their academic background. Therefore, the ranking order used in the analysis was: lecturer, senior lecturer, assistant professor, associate professor, and full professor. The analysis of psychometric properties of 17 items of the tool was carried out comparing with the results of Carbonell et al. (2016) for the validity and improvement of the tool.

Excel file exported from Qualtrics XM software was imported into the SPSS and data was labelled by assigning appropriate codes. Out of 17 items, two (Items 9 and 17) were scored reversely as they were phrased (interpreted) negatively (Carbonell et al., 2016). Kaiser-Meyer-Olkin measure of Sampling Adequacy and Bartlett's Test of Sphericity were performed before conducting statistical analysis to see whether the sample size was adequate. Normality test was also performed before running the EFA and CFA. Cronbach's alpha values were calculated for all factors (dimensions) to check for internal consistency. Descriptive statistics was employed to inspect the profile of the sample. $P< 0.05$ was considered as statistically significant in all calculations.

CHAPTER 4

4. Results

The total sample included 40 academics whose age range was from 27 to 64 years (Table 4). CFA showed that significant numbers of items of the domain and innovative skills dimensions contributed to the research model (Figure 2) with a statistical significance. In contrast, the metacognitive skill was not statistically significant (Table 9). Model fit indices indicated that a good model fit was achieved (Table 12).

A higher score for the domain skill dimension was noted than that for the innovative skill while these scores were greater among professors than lecturers (Table 14). Also, internal consistency within domain skill dimension (0.81) was greater than that in the innovative skill dimension (0.57). The mean score of adaptive expertise of the sample was 4.18 out of 5.

Scores of adaptive expertise and domain and innovative skills dimensions showed statistically significant positive relationships with perceived work performance and academic rankings. In contrast, no relationships were noted with age and work experience (Table 17).

4.1 Demographic Information of the Sample

The sample consisted of 20 females, 19 males and one with no gender identity indicating a balanced gender representation in the sample. The age range was from 27 to 64, and the mean age was 45.95 with SD 11.84 years. The majority of the participants were in the category of lecturer followed by assistant professor, full professor, senior lecturer, and associate professor. The researcher category was least represented in the sample (Table 4). There were two participants whose ranks were not revealed. The mean experience of present occupants of each category are shown in the Table 4.

Table 4

Demographic Composition of the Sample

	Age			Work Experience (Present Rank)			Gender		
Academic Ranking	*N*	*M*	*(SD)*	Median	*M*	*(SD)*	Male	Female	Not Revealed
Lecturer	10	43	12.61	3	2.9	1.2	2	8	
Senior lecturer	5	53.2	11.03	4	4	1.22	2	3	
Senior researcher	1	55		1	1		1		
PhD student	2	28.5	2.12	2	2			2	
Post -Doc	1	30		2			1		
Assistant professor	9	45	10.6	2	2.89	1.36	5	4	
Associate professor	3	44.33	6.43	4	3.33	2.08	2	1	
Full professor	7	56.43	3.87	5	4.71	0.49	5	1	1
Not revealed	2	33.5	9.19	1.5	1.5	0.71	1	1	

Table 5 shows results of Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity indicating the adequacy of the number of the present sample for statistical testing of EFA and CFA and other statistical tests. The Kaiser-Meyer-Olkin is a statistical test that is used for the measurement of the sampling adequacy and it indicates the proportion of variance in the variables that might be caused by underlying factors. Bartlett's test of Sphericity examines whether the variance–covariance matrix is proportional to an identity matrix (Field, 2013). According to the guidelines regarding KMO values and the adequacy of the sample, values in the 0.60s is a mediocre value (Field, 2013). Furthermore, a test should be significant to be acceptable for valid statistical analysis (Field, 2013). As the present test appeared to be significant ($p < 0.001$), and KMO value was 0.63. Therefore, it is safe to assume that the sample size is adequate for further statistical testing.

Table 5

Sampling Adequacy Test: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.633
Bartlett's Test of Sphericity	Approx. Chi-Square	274.692
Degree of freedom		136
Significance		0.000*

4.2 Which Dimensions are Characteristic of Adaptive Expertise of University Teachers?

The mean and median values for the responses of participants for the 17 items which are categorised into three dimensions are shown in the Table 6 (Annexure 2). The highest total mean score was noticed for domain dimension followed by innovative and metacognitive skills dimensions when scores of all 17 items were added.

To find the answer to the question about dimensions (characteristics) of adaptive expertise of university teachers, results of CFA were analysed and checked for model fit. Three dimensions of adaptive expertise (Domain, Metacognitive and Innovative skills) were analysed using the same seventeen items used by Carbonell et al. (2016) as shown in the research model (Figure 2). Accordingly, if CFA results can show acceptable model fit indices, three dimensions of adaptive expertise of university teachers could be similar to the three dimensions shown in Figure 2.

4.2.1 Confirmatory Factor Analysis

Anderson Normality Test conducted before the CFA indicated that the variables (item responses) were not in a normal distribution (Table 7 Annexure 3). Therefore, nonparametric Spearman Rank Correlation test was conducted to see the correlation between the items. The results of correlation matrix revealed the presence of significantly high coefficients (Figure 3).

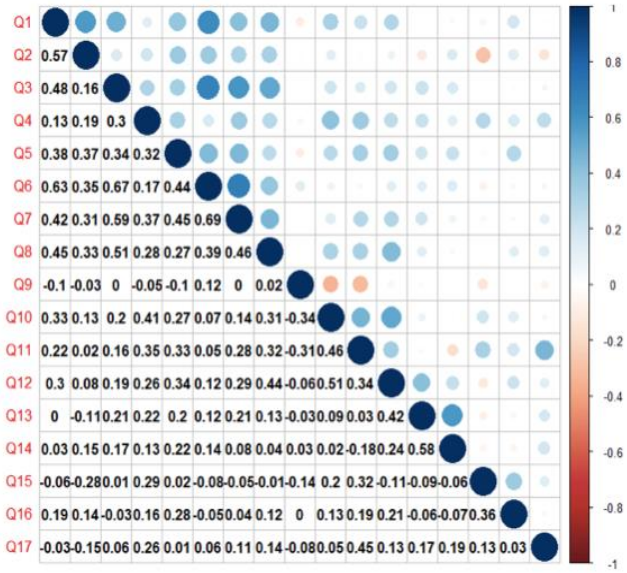

Figure3. Spearman Rank Correlation test results

CFA indicates that a good model fit has the following indices: RMSEA (Root Mean Square Error of Approximation) and SRMR (Standardized Root Mean Square Residual) should be below 0.08 and CFI (Confirmatory Factor Index) and TLI (Tucker Lewis Index) index should be above 0.9 (Schmitt, 2011). In the first round of

CFA, model fit indices (RMSEA = 0.098, SRMR = 0.154, CFI = 0.782, TLI = 0.744) showed that the selected model with 17 items (shown in figure 2) was not well accepted. Therefore, the significant level of each item was observed, and numbers of insignificant items were noted. There were seven insignificant items (Items 4, 9, 10, 12, 15, 16, 17) and they are shown in the Table 8. While all the items in the domain dimension showed a higher significance, some items of the metacognitive and innovative domains were shown to be insignificant.

Table 8

CFA analysis showing the significance levels and factor loading when all 17 items were included in the model as in the research model

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all (Factor loading)
Items of Domain =~						
Q1	0.749	0.129	5.795	0.000	0.749	0.774***
Q2	0.280	0.095	2.936	0.003	0.280	0.443**
Q3	0.544	0.092	5.940	0.000	0.544	0.788***
Q5	0.629	0.138	4.573	0.000	0.629	0.648***
Q7	0.471	0.078	6.034	0.000	0.471	0.797***
Items of Metacognitive =~						
Q4	0.126	0.088	1.429	0.153	0.126	0.254
Q10	0.074	0.144	0.515	0.606	0.074	0.089
Q13	0.528	0.184	2.865	0.004	0.528	0.900**
Q14	0.422	0.160	2.634	0.008	0.422	0.686*
Items of Innovative =~						
Q6	0.649	0.125	5.208	0.000	0.649	0.731***
Q8	0.422	0.108	3.912	0.000	0.422	0.559***
Q9	-0.130	0.119	-1.096	0.273	-0.130	-0.134
Q11	0.241	0.098	2.469	0.014	0.241	0.327*
Q12	0.086	0.070	1.231	0.218	0.086	0.151
Q15	-0.063	0.064	-0.984	0.325	-0.063	-0.120
Q16	0.052	0.076	0.690	0.490	0.052	0.083
Q17	-0.044	0.093	-0.477	0.634	-0.044	-0.057

Note. Significance level * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

As the insignificant items are not contributing to the model significantly, another CFA was made excluding the insignificant items and results showed a good model fit statistics (RMSEA = 0.062, SRMR = 0.085, CFI = 0.97, TLI = 0.957) as indicated by Schmitt, 2011. Table 9 shows the significant items and their factor loading. While all items of the domain dimension were highly significant, none of the items of the metacognitive dimension were statistically significant.

Table 9

CFA analysis showing factor loading when insignificant items were excluded from the model

	Estimate	Std.Err	Z - value	P(>I z I)	Std. Iv	Std. all (Factor loading)
Domain =~						
Q1	0.740	0.130	5.686	0.000	0.740	0.766***
Q2	0.271	0.096	2.805	0.005	0.271	0.428**
Q3	0.554	0.091	6.076	0.000	0.554	0.802***
Q5	0.619	0.139	4.452	0.000	0.619	0.637***
Q7	0.474	0.078	6.077	0.000	0.474	0.802***
Metacognitive =~						
Q 13	0.496	0.401	1.238	0.216	0.496	0.845
Q 14	0.451	0.368	1.227	0.220	0.451	0.734
Innovative =~						
Q6	0.650	0.126	5.171	0.000	0.650	0.732***
Q8	0.445	0.109	4.073	0.000	0.445	0.590***
Q11	0.256	0.101	2.540	0.011	0.256	0.346*

Note. Significance level * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

4.2.2 Comparison of Items with the Study of Carbonell et al. (2016)

As the current study used the tool developed by Carbonell et al. (2016), the present results were compared with that of the former. Like in the study of Carbonell et al. (2016) which reported domain-specific and innovative skills as the significant

contributors to adaptive expertise, the present results also showed that items of the domain and innovative skills were significant contributors to the adaptive expertise of university teachers. However, items which were significant and validated specially for measurement of innovative dimensions were different in the two studies. Table 10 shows the differences between the two studies when considering the statistical significance of the items analysed.

Table 10

Comparison of Items Between Two Studies Regarding Contribution of Items to the Model Significantly

Items	Carbonell et al. (2016) study		Present study	
	Yes	No	Yes	No
Item No				
Domain				
1	√		√	
2	√		√	
3	√		√	
5	√		√	
7	√		√	
Innovative				
6	√		√	
8	√		√	
9		√		√
11	√		√	
12	**x**			**x**
15	**x**			**x**
16		√		√
17		√		√
Metacognitive				
4		√		√
10		√		√
13		√		√
14		√		√

Note. Differences were noticed items 12 and 15 among two studies.

4.2.3 Exploratory Factor Analysis and Confirmatory Factor Analysis

Due to the differences of the items in the innovative dimension between the two studies (Table 10) independent factor extraction was performed using EFA followed by CFA. For factor extraction, Principal Components Analysis (PCA) was selected and components were rotated by applying a direct oblimin method with a specified number (Three) of components. The table 11 (Annexure 4) shows results of EFA where minimum factor loading was considered as 0.4 and items were sorted by their size. Accordingly, the distribution of items among the three components were different specially in the metacognitive and innovative skill dimensions compared to the research model (Figure 2).

Results of CFA on the extracted components revealed the following model fit indices: Root mean Square Error of Approximation (RMSEA) = 0.071 and Standardised Root Mean Square Residual (SRMR) = 0.119, Confirmatory Fit Index (CFI) = 0.897 and Tucker-Lewis Index (TLI) = 0.877. As CFI and TLI are less than 0.9, it appears that a satisfactory significant model fit was not achieved.

4.2.4 Which Model and Which Dimensions?

Finally, model fit indices of the three models were compared to identify the best fit model and Table 12 shows that the second model, which included only the domain and innovative skills gave the best model fit.

Table 12

Comparison of Model Fit Indices

Models	CFI	TLI	AIC	BIC	RMSEA	SRMR
1	0.782	0.744	1347.561	1410.050	0.098	0.154
2	0.970	0.957	758.208	797.052	0.062	0.085
3	0.897	0.877	1232.927	1292.038	0.071	0.119

Note. Model 1 considered all 17 items with no removal of any items; Model 2 considered only significant items, and Model 3 contains items after ECA. As model 2 shows, the highest CFI and TLI values than other two models and lowest in the AIC, BIC, RMSEA and SRMR, model 2 was selected as the best fit.

Table 9 shows the factor loadings of items and their contribution to the research model with the level of significance ($p < 0.05$). Strong loading and statistically significant contribution to the research model were identified in all the items of the domain skill dimension. Similarly, some items of the innovative skill dimension were shown contributing to the model with a statistical significance. In contrast, items of the metacognitive dimension did not show a significant contribution to the research model. Further, strong and significant loading was identified in the items of the domain skill dimension than that of the innovative skill dimension.

When covariances between three dimensions of adaptive expertise were analysed using the Z test, results showed a strong relationship between domain skill and innovative skill but none with the metacognitive skill (Table 13). Covariance shows the association between variables and it assesses whether two variables are related to each other (Field 2013). A positive covariance between dimensions of domain and innovative skills indicates that both variables behave in the same manner.

Table 13

Covariance between dimensions

Dimensions	Estimate	Std.Err	Z - Value	P(>|z|)	Std.lv	Std.all
Domain~~ Metacognitive	0.066	0.193	0.340	0.734	0.066	0.066
Domain ~~ Innovative	1.226	0.103	11.848	0.000***	1.226	1.226
Metacognitive ~~ Innovative	0.021	0.222	0.096	0.923	0.021	0.021

Note. Significance level * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Furthermore, Figure 4 shows the path diagram based on the results of CFA of model 2 indicating the regression weights for each dimension and correlation coefficients between the three dimensions. Although a good correlation (coefficient = 1.23) was found between domain skill and innovative skill dimensions, there was no correlation with metacognitive skill. Therefore, answering the research question about the dimensions of adaptive expertise among university teachers, it could be speculated that domain and innovative skills are the main dimensions of adaptive expertise of the present sample of university teachers.

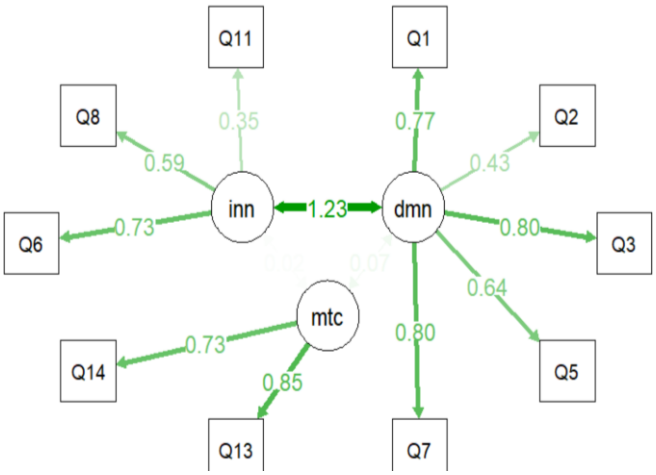

Figure 4. A path diagram of CFA representing the factors structure of the adaptive expertise. Intensity of the lines indicates the strength of the factor loading. Note that there is no covariance of metacognitive dimension. Key: Inn: Innovative skill dimension; dmn: Domain skill dimension; mtc: metacognitive skill.

4.3 Scores of Adaptive Expertise its Dimensions and Perceived Work Performance

The mean score values of adaptive expertise, domain and innovative skills dimensions are shown in Table 14. These scores were computed by calculating the mean values of the items selected for model 2, which included items of the domain and innovative skill dimensions.

Table 14

Mean Scores of Adaptive Expertise and its Dimensions Among Different Academic Ranks

		Domain		Innovative		Total (Adaptive Expertise)	
Academic rank	*N*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Lecturer	10	3.82	0.77	3.75	0.35	3.74	0.75
Senior lecturer	5	4.16	0.80	3.93	0.22	4.07	0.62
Senior researcher	1	4.20		4.00		4.25	
PhD student	2	4.60	0	4.00	0	4.50	0
Post -Doc	1	4.60		4.25		4.62	
Assistant professor	9	4.44	0.33	3.96	0.34	4.36	0.33
Associate professor	3	4.53	0.50	3.75	0.22	4.46	0.52
Full professor	7	4.48	0.51	3.89	0.54	4.36	0.53
Not revealed	2	4.30	0.14	3.87	0	4.31	0.09
Total sample	40	4.26	0.60	3.87	0.34	4.18	0.57

It is noted that the professors scored higher values for adaptive expertise than those scored by the lecturer and senior lecturer categories when the mean was calculated from the item responses. Although the researcher group (senior researcher, PhD student and Post-doc) also showed a higher value than those scored by the lecturers and the senior lecturer, it is difficult to comment on this due to the limited number of participants in the research group. Therefore, adaptive scores of four categories of university teachers (Lecturer, Senior Lecturer, Assistant Professor, Associate Professor & Full Professor) were compared to see if there were significant differences among them using the Kruskal-Wallis test which is a test for the comparison of more than two independent groups of categorical data. Although a greater score was noticed among professors than the score among lecturers, a statistically significant difference was not noticed (Table 15).

Table 15

Kruskal-Wallis Test Summary of Comparison of Adaptive Scores among five AP

Parameter	Value
Total number	34
Minimum	1.88
Maximum	5.00
Mean	4.14
Std. Dev	0.61
Test Statistics	7.16
Degree of Freedom	4.00
Asymptotic Sig 2	0.13

Note. AP: Academic ranks; Lecturer, Senior Lecturer, Assistant Professor, Associate Professor & Full Professor

Perceived work performance was calculated by taking the mean scores of the ratings given for three statements about perceived work performance. Since the scale was rated from 1 to 10 the total score was calculated out of 10. Relatively high score rate was observed for the perceived work performance from the sample (Table 16).

Table 16

Mean Scores of Perceived Work Performance Among Teaching Staff

Score from the rating from 1 to 10					
Academic rank	*N*	*M*	*(SD)*	*Min*	*Max*
Lecturer	10	6.97	1.41	3.67	8.67
Senior lecturer	5	7.8	0.93	7.00	9.33
Assistant professor	9	7.52	0.76	6.67	9.33
Associate professor	3	8.00	0	8.00	8.00
Full professor	7	7.14	0.74	6.00	8.00
Total sample	40	7.37	0.95	3.67	9.33

4.4 Relationship of Adaptive Expertise with the Perceived Work Performance, Experience and Academic Ranking

When adaptive expertise scores were correlated with perceived work performance and academic rankings, statistically significant correlations were noted (Table 17). Furthermore, scores of domain and innovative skills dimensions also showed similar positive correlations with perceived work performance and academic rankings. All correlations were positive and ranged from 0.35 to 0.43 (Table 17). These results depicted that both second and third hypotheses were confirmed. Accordingly, adaptive expertise showed a positive correlation with perceived work performance and academic ranking. However, there were no correlations between work experience and scores of adaptive expertise or with any of its dimensions (Table 17). Accordingly, fourth hypothesis was not confirmed. Therefore, there was no any correlation between work experience and adaptive expertise or its dimensions.

Table 17

Spearman's Rank Correlations Results Indicating Relationships of Adaptive Expertise Score

Variables	*N*	*r*	*p*
Perceived work performance & adaptive expertise	32	0.406*	0.021
Perceived work performance & domain skill	32	0.371*	0.0137
Perceived work performance & innovative skill	32	0.363*	0.041
Academic ranking & adaptive expertise score	34	0.423*	0.013
Academic ranking & Domain skill	34	0.427*	0.012
Academic ranking & Innovative skill	34	0.348*	0.044
Experience (PP) & adaptive expertise score	40	-0.166	0.305
Experience (PP) & domain skill score	40	-0.116	0.475
Experience (PP) & Innovative skill score	40	-0.23	0.148
Age & adaptive expertise	40	0.124	0.522

Note. Significance level * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Reliability analysis is necessary to assess the consistency of a measure. Internal consistency measurements (Cronbach alpha values) of domain and innovative skill dimensions and of perceived work performance are shown in Table18. This indicates that the reliability was higher in the measuring items of domain skill (items 1, 2, 3, 5, 7) than that for the items of innovative skill (items 6,8,11).

Table 18

Internal Consistency of Three Different Constructs

Name of Construct	Cronbach Apha
Domain skill dimension	0.81
Innovative skill dimension	0.57
Perceived work performance	0.63

CHAPTER 5

5. Discussion

In answering to the first research question, domain and innovative skills were identified as the significant dimensions of adaptive expertise among university teachers. Similar to the study of Carbonell et al. (2016), the present data could not detect a significant contribution of the metacognitive skill dimension to adaptive expertise. As a higher score for the domain skill dimension was noted than that for the innovative skill (Table 14), it appears that the contribution from the domain skill dimension could be greater for adaptive expertise among university teachers. The relatively high adaptive expertise score (4.18 out 5) of the sample implies that the university teachers possess already a significant level of adaptive expertise.

Although the present study reconfirmed the findings of the Carbonell et al. (2016), detailed analysis of the literature shows that it is difficult to exclude the metacognitive skill from the dimensions of adaptive expertise. Besides, it seems that the items for measuring the metacognitive skills are less likely to capture certain aspects of metacognition such as time allocation, selection strategies, prediction of difficulty and monitoring (Sternberg 2001). Therefore, suggestions for improvement of the measuring tool developed by Carbonell et al (2016) is discussed.

Regarding the second research question about the influence of adaptive expertise on perceived work performance, a positive relationship between adaptive expertise and perceived work performance was noted. This indicates the timely importance of the need for the development of adaptive expertise among university teachers.

The finding of a statistically significant correlation between adaptive expertise and academic rankings but not with the work experience has not been reported previously. This is an interesting finding because one would expect higher ranking academics to have greater work experience. Therefore, this finding needs further investigation. However, it has been reported that organisation of knowledge is more important than the extent of knowledge in adaptive expertise.

The summary of results is shown in the Figure 5.

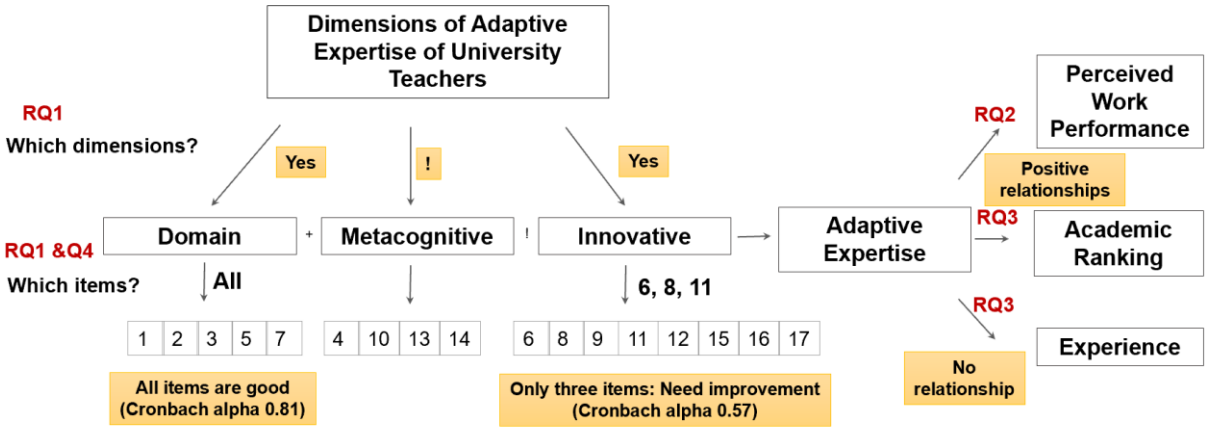

Figure 5. Significant dimensions were domain and innovative skills dimensions. Adaptive expertise showed positive relationship with perceived work performance and academic ranking.

5.1 Dimensions of Adaptive Expertise of University Teachers

The literature on dimensions of adaptive expertise highlights the significance of domain skills and innovative skills although the role of metacognitive skills remains a controversy. The former two dimensions have been identified as the key features of adaptive expertise by several researchers (Hakano & Inagaki, 1986; Hutton et al., 2017; Schwartz et al., 2005). The present study also identified the domain and innovative skills dimensions as prominent components of the adaptive expertise of this sample. This study found a statistically significant contribution of items of the above two domains (Table 9 and Figure 4) to adaptive expertise. Furthermore, average score of domain skill dimension was greater than that for the innovative skill (Table 14). This observation implies a strong contribution of the domain skill dimension to the adaptive expertise of university teachers. This is further confirmed by the observation of better internal consistency of the items of the domain skill dimension (Cronbach alpha 0.81) than that in the innovative skill dimension (0.57). Carbonell et al. (2019) viewed that the domain skills gauge an individual's readiness to adapt, whereas innovative skills tap into their ability to modify current knowledge and skills.

The domain skill of adaptive experts is characterised by more extensive and integrated knowledge base, deep understanding of the relevance of knowledge and its' dynamic and evolving nature compared to the static knowledge of routine experts (Hatano & Inagaki, 1986). Chi (2011) has also described that adaptive experts acquire a deep conceptual understanding of the skill within their domain by intentionally seeking challenges, reflecting on their performance, and thus engaging in continuous learning. Therefore, adaptive experts possess a greater motivation to achieve a deep understanding of domain-related knowledge and skill. Further, they are keen on why and under which condition a specific domain-relevant skill must be applied or new methods need to be devised (Carbonell et al., 2016). Another difference between adaptive experts and routine experts is knowledge representation (Hatano & Inagaki, 1986).

The theoretical assumption is that the structure or representation of experts' knowledge is a primary determinant of how experts learn, reason, remember, and solve problems (Chi, 2006). Experts have a great deal of well-organised content knowledge (domain) and hence they easily notice meaningful features and information. Further, they are able to retrieve their knowledge quickly with little effort and to frame problems in a deep and principled manner (Rayne et al., 2006). Also, a hierarchical knowledge representation which involves entities that are embedded in one another is speculated for adaptive experts (Chi & Ohlsson, 2005). Costa, & Kallick (2009) have reported that the experts' problem representation is more abstract, that is, at a deeper or more theoretical level. Thus, in many areas, expert reasoning shows evidence of deeper processing, suggesting a more causally interconnected, and more theoretical or abstract, knowledge base (Costa, & Kallick, 2009).

In the context of university teachers, deep conceptual understanding of the domain is required for both teaching and research activities which are the fundamental duties of academics. Also, they need to look for interconnectedness between theories and observations with a sound technical and scientific background. As academics in higher education with responsibilities for research and teaching, university teachers should be knowledgeable and up to date in the domain by the continuous acquisition of new domain knowledge and skills. The adaptive expertise demands "flexible knowledge and performance" to be able to respond to novel situations effectively and

efficiently (Hatano & Inagaki, 1986). The features of adaptive expertise which distinguish them from routine expertise is the ability to verbalise the principles underlying one's skill, and the capacity to modify ways of working to address specific needs and constrains in a task (Hatano & Inagaki, 1986). Hayden, Rundell & Smyntek-Gworek (2013) have identified that the teachers with adaptive expertise are deeply knowledgeable about "what they do, how they do it, and why they ply their practices with great adeptness".

Based on a research study conducted among students and teachers, Wood and Fen Su (2017) have reported that the excellent university teacher has expertise in their subject discipline and is skilled in pedagogic approaches that encourage learner independence and critical thought. Teachers with adaptive expertise can combine "inquiry habit of mind" in the form of instructional adaptations developed from evidence of student learning, resulting in a more responsive and dynamic teaching (Hayden, et al., 2013). During the present pandemic, university teachers cannot apply traditional techniques and need to look for innovative teaching techniques to promote, regulate and assess students' learning while both parties are working from home. Therefore, university teachers with good problem-solving skills and ability to move beyond existing pedagogy will be able to innovate imaginative methods for promoting teaching and learning environment during the pandemic. In this way, teachers with good adaptive expertise can enhance students' desire to learn and experience exciting yet 'safe' learning opportunities. Therefore, university teachers should keep up to date with their knowledge and use skilled innovative approaches to motivate students' learning. Moreover, these teachers need a deep understanding of the subject domain and interconnectedness between theory and practice. This may be the underlying reason for the present observation that domain and innovative skills dimensions are significant contributors to adaptive expertise among university teachers.

The acceptable model identified from the statistical analysis of the present data depicted only two dimensions (domain skills and innovative skills) contributing to the adaptive expertise of the university teachers whereas the contribution of metacognitive skill did not appear to be statistically significant. Therefore, the first hypothesis that the tool developed by Carbonell et al. (2016) can capture all three dimensions (domain, metacognitive and innovative skills) which would influence the adaptive

expertise of university teachers is only partially correct. Although the findings of the present study reconfirmed the empirical evidence that adaptive expertise develops along two dimensions – domain and innovation (Carbonell et al., 2014; Carbonell et al., 2016; Carbonell,& van Merrienboer, 2019; Martin, Rivale, & Diller, 2007) the answer to the contentious question about the role of metacognitive skill dimension in adaptive expertise among university teachers is not adequately answered. Whilst metacognitive skill was conceptualised as a defining characteristic of adaptive expertise by some researchers (Feltovich et al., 2006; Lin, Schwartz & Hatano, 2005; Männikkö & Husu, 2019), results of the studies of Carbonell, et al. (2014 & 2016) and ours did not show statistical significance for items which predict metacognitive skill dimension in the present model.

However, the literature is not clear on the exact role metacognitive skills play in the development of adaptive expertise (Carbonell, et al., 2014 & 2016). Some researchers believed that metacognitive skill is a part of routine expertise (Hatano & Inagaki, 1986; Hatano & Oura, 2003) whereas others suggest that individuals with adaptive expertise possess better metacognitive skills than those with routine expertise (Crawford et al., 2005; Fisher & Peterson, 2001; Martin et al., 2007). However, Carbonell, et al. (2016) reported that there was no evidence in existence for either of these positions following an extensive literature review of adaptive expertise conducted by them previously (Carbonell, et al., 2014). Moreover, it has been pointed out that routine and adaptive expertise do not oppose each other; rather, adaptive expertise builds on routine expertise (Carbonell, et al., 2014; Schwartz et al., 2005). Also, Carbonell, et al. (2016) stated that metacognition did not seem to aid in distinguishing adaptive expertise from routine expertise based on a study conducted among professionals and graduates.

Metacognition enables humans to step back and think through problems rather than simply reacting instinctively (Gunstone, & Mitchell, 2005). Johanna, and van der Heijden (2000) are of the view that knowledge dimension is closely related to the metacognitive skill dimension (i.e. knowing about knowing or knowing that one knows). It seems that the authors used the word “knowledge dimension” to describe the domain dimension. As reported previously, the adaptive experts’ problem representations were more abstract, that is, at a deeper or more theoretical level

(Hatano & Inagaki, 1986; Hatano & Oura, 2003). In other words, expert reasoning shows evidence of deeper processing, suggesting a more causally interconnected, and more theoretical or abstract, knowledge base (Gunstone & Mitchell, 2005).

Metacognitive awareness includes perceptions of the purpose of the current activity and personal progress through the activity (Gunstone & Mitchell, 2005). The process of recognising existing conceptions, evaluating them, deciding whether to reconstruct, and reviewing are all metacognitive processes; they require appropriate metacognitive knowledge, awareness, and control (Gunstone & Mitchell, 2005). Therefore, it appears that the deep conceptual understanding is a result of linking of conceptual knowledge with metacognition. Besides, metacognitive processes allow us to learn from prior experiences, generalise learning so that we can apply strategies to new situations, evaluate the utility of different approaches, and decide how we might do things differently next time (Costa & Kallick, 2009). Accordingly, it seems that deep understanding and interconnectedness to theory and application of them to new situations are not possible without metacognitive skills.

In the context of university teachers, it can be argued that metacognitive processes such as interconnecting previous knowledge, with experience and reconstructing new strategies to different situations are frequently used especially in the research environment. Besides, this phenomenon is necessary for solving problems during research which a researcher encounters frequently. For example, results of an experiment cannot always be expected as postulated in the hypothesis. Then the researcher has to seek out rational and scientific explanations for the unexpected results and then make appropriate changes to the experimental procedure to arrive at a rational conclusion from the experiment. In education, teachers need to assess students' learning and practise adaptive teaching considering the learning progress of students and other constraints the situation may present. Accordingly, metacognitive awareness such as perceptions of the personal progress, recognition of existing concepts and evaluating them is essential for university teachers. Therefore, the influence of metacognition on adaptive expertise cannot be overlooked or underestimated. One might argue that if that is the case, this study should have shown a significant contribution of metacognition on adaptive expertise. However, there may be other factors at play: the number of items in the measuring tool and their

sensitivity designed to capture data related to metacognition. Therefore, it is important to discuss the capacity and the sensitivity of the measuring tool to capture these aspects of metacognition for identification of the role of metacognitive skill dimension in the adaptive expertise among university teachers.

Sternberg, (2001) viewed that metacognition converged with other attributes as part of the concept of developing expertise. For example, some of the characteristics of expertise, such as time allocation, development of representations, selection of strategies, prediction of difficulty, and monitoring are all aspects of metacognitive functioning (Sternberg, 2001). Thus, metacognition represents an important part of developing expertise. The above characteristics are common to university teachers during activities in the academic environment. Therefore, exploration of items in the measuring tool used in the present study is useful for further research. It seems plausible that the items in the tool used in the present study failed to capture the above attributes of metacognition which are important for adaptive expertise. There were four items used in the Carbonell's (2016) study to measure metacognitive skill dimension and they are shown below:

- "I was able to indicate the cause of any obstacles which emerged"
- "I sought out feedback"
- "I was able to assess when my knowledge is insufficient to perform a specific task or solve a particular problem"
- "I was able to assess what skills I do not possess to perform a certain/specific task or solve a particular problem"

It appears that the above items can observe mainly the ability to know "what we know and what we don't know" (Costa & Kallick, 2009; Livingston, 1997) and prediction of difficulty. However, these items cannot comprehend other important aspects of the metacognition functions such as time allocation, development of representations, selection of strategies and monitoring (Sternberg, 2001). Therefore, it is difficult to state that metacognitive skill is not a dimension of adaptive expertise of university teachers although the study of Carbonell et al. (2016) and the present

results identified only domain and innovative skills dimensions to be significant in the dimensions of adaptive expertise. And it is suggestive of a need to improve the measuring tool and undertake further studies by incorporation of new items for metacognitive skills to enable researchers to make a definite conclusions about the role of metacognition in adaptive expertise.

5.2 Adaptive Expertise and Perceived Work Performance

The results of Spearman's Rank Correlation non-parametric test which assessed the relationship between (different dimensions of) adaptive expertise and perceived work performance during the altered academic environment supported the second hypothesis that there is a positive correlation between adaptive expertise of university teachers and their perceived work performance. Accordingly, it appears that adaptive expertise and its two dimensions (domain and innovative skills) exert positive influence on perceived work performance (Table 17). As a rule of thumb, correlation (r) values between 0.0 and 0.1 are negligible, values between 0.1 and 0.39 are weak, values between 0.4 and 0.69 are moderate, values between 0.7 and 0.89 are strong and values above 0.9 are very strong (Schober et al., 2018).

Although the present results show a moderate correlation (r = around 0.4) between perceived work performance and adaptive expertise and its dimensions (domain and innovative skills), they highlight the importance of developing adaptive expertise among university teachers to increase their work performance. This moderate correlation may be due to the small sample size and the limited number of questions which assessed the perceived work performance. Although it was planned to calculate the number of sessions completed by the university teachers during the COVID-19 pandemic, it was not successful due to inadequate data. From a study conducted among 240 Indian university teachers, Bhat and Beri (2016) reported that adaptive performance was positively correlated with the score of perceived job performance while validating a tool for measuring perceived job performance. In the above study, authors referred to the “adaptive performance” to mean the extent of adaptation to changes at the workplace using the definitions given by Griffin et al. (2007) for adaptive expertise.

It is reasonable to state that COVID-19 pandemic can give rise to situational constraints as it has altered the standard work environment to a non-standard situation. Bacharach and Bamberger (1995) reported that situational constraints are negatively related to job performance. Workplace factors that potentially hinder job performance are called “stressors” which impede job performance directly and indirectly. Some authors have classified different stressors as hindrance versus challenge (LePine, Podsakoff, & LePine, 2005). Situational constraints are hindrance stressors which are negatively related to job performance while challenge stressors such as demands, pressure, time urgency, and workload enhance job performance (Sonnentag et al., 2008). However, Fay and Sonnentag (2002) reported a positive relationship between situational constraints (a hindrance stressor) and personal initiative which can be defined as a behavioural pattern. Personal initiative behaviour results in an individual taking an active and self-starting approach to work goals and tasks and persisting in overcoming barriers and setbacks (Fay, & Frese, 2001). Thus, the present finding of a positive relationship between adaptive expertise and perceived work performance suggests that although the hindrance stressors seem to impede task performance, this does not have to be true for adaptive experts. Sonnentag et al. (2008) reported that there is increasing evidence that job stressors do not necessarily impair job performance, by using a meta-analysis. Furthermore, Beal, Weiss, Barros, & MacDermid (2005) reported that work performance is positively influenced by a person's general resource level (e.g., cognitive ability, task-relevant skills) and the momentary allocation of these resources which could be considered as features of adaptive expertise.

5.3 Adaptive Expertise, Academic Ranking and Work Experience

According to the calculation of the score for adaptive expertise, the maximum score could be 5 (five) points. Relatively higher mean scores (4.18) for adaptive expertise observed in the present sample may indicate that adaptive expertise among university teachers has been developed to a considerable extent. Although the adaptive expertise score is greater among professors than lecturers, this difference was not statistically significant (Tables 14 & 15). This may be due to the small sample size (34) and the inadequacy of the numbers in each group with unequal distribution (3 vs 10) among the groups.

However, the statistically significant positive correlation (Table 17) between academic ranks and adaptive expertise score and its dimensions (domain and innovative skills) supports the third hypothesis that there is a positive correlation between adaptive expertise and academic ranking of university teachers. It is plausible to speculate that adaptive expertise could have influenced the attainment of higher academic ranks among university teachers although this requires further investigation with a bigger sample. It is my understanding that professional characteristics of university teachers may be different from other professionals because they are target-oriented, motivated high achievers with increased working capacity and recruited to universities based on best academic qualifications. Lierse, (2016) and Horokhivska (2019) have also reported similar ideas regarding characteristics of university teachers from two studies conducted in Poland and Australia. Perhaps university teachers with more of these qualities may reach higher academic ranks sooner than those who do not possess such qualities. If these high achieving qualities are shared with adaptive expertise, it is reasonable to speculate that there is a relationship between academic ranking and adaptive expertise. However, further studies are needed to make a definite conclusion about the above relationship.

Generally, it is reasonable to expect that work experiences can increase the amount of knowledge and thus also the adaptive expertise. However, the present results did not support the fourth hypothesis that there is a relationship between adaptive expertise and work experience of university teachers. Similarly, the study of Carbonell et al. (2016) reported that there was no relationship between adaptive expertise and work experience, but task variety was related to the level of adaptive expertise, by studying a sample of 216 graduates and 172 professionals. Another study conducted among schoolteachers also stated that teachers with more teaching experience seemed to be less adaptive than those with less teaching experience (Männikkö & Husu, 2019). The results of the present study recounted the same conclusion as adaptive expertise score did not show any relationship with either work experience or the age of university teachers (Table 17). This indicates that adaptive expertise is not auto-generated or acquired with seniority automatically, but it is a skill which should be developed intentionally.

It is also plausible to state that although the experience can increase the extent of knowledge, it does not necessarily increase adaptive expertise. This implies that the knowledge representation is more important than the extent of knowledge in adaptive expertise as reported previously (Chi, 2006; Carbonell et al., 2014; Schwartz et al., 2005). Individuals with adaptive expertise possess a more extensive and integrated knowledge base than individuals with routine expertise (Hatano & Inagaki, 1986). This helps adaptive experts to make a conscious effort to deal with an unfamiliar situation by building a mental model of the situation, in which they draw analogies between standard and novel situations (Barnett & Koslowski, 2002; Chi, 2006). However, Carbonell et al. (2016) believed that generally, employees who have several years of work experience can gain adaptive expertise if their innovative skills are stimulated. Accordingly, it is reasonable to suggest that induction programmes are necessary for the development of adaptive expertise irrespective of the age and working experience of university teachers so that work performance could be improved among them.

5.4 Comparison of Psychometric Properties of the Tool with the Study of Carbonell et al. (2006)

It is useful to compare the findings of the current study with that of the study of Carbonell et al. (2016) for improvement of the measuring tool and for future studies. Although the present results reconfirm the core findings of Carbonell et al. (2016) that adaptive expertise comprises of the two dimensions of domain and innovative skills, some differences were found among items in the innovative skill dimension (Table 10). Eight items had been identified as depicting innovative skill in the original model, but only three items were statistically significant in the present study compared to the study of Carbobell et al. (2016) which showed five significant items. Besides, Cronbach alpha was below 0.6 for those items of innovative skill dimension in the current study. It is difficult to decide whether these discrepancies in the results are due to the different population sample or inadequate sample size or whether the items of innovative skill dimension need modifications and improvements.

In addition to the dimensions of adaptive expertise, other similarities between the two studies were the validity of items in the domain dimensions and the

identification of insignificant items (Table 10). As the following items were found to be insignificant in both studies, they could be dropped or modified in future studies.

- “I approached new tasks/projects in similar ways as I worked in the past.”
- “I was able to adapt my work habits to the needs of the situation.”
- “When I was confronted with obstacles or difficult situations, I gave up.”

Finally, it could be concluded that when considering the dimensions (characteristics) of adaptive expertise of university teachers, domain and innovative skills are strong determinants. However, as explained previously, the deep conceptual understanding is a result of linking of conceptual knowledge with metacognition. McKenna (2014) stated that innovation relates to inquiry of self-regulating skills necessary to identify and comprehend a problem, identify what additional knowledge is necessary, and generate ideas and leverage existing knowledge to facilitate recognition of relevant information. These are partly functions of metacognition (Sternberg, 2001). Therefore, in my opinion, the dimensions of adaptive expertise could be explained by using an example of a sandwich where two bread slices are the domain and innovative skills dimensions, while the filler is the dimension of metacognitive skill (Figure 6).

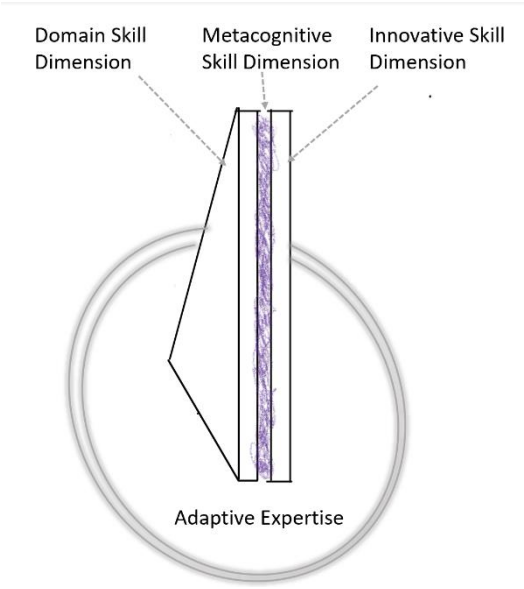

Figure 6. An example for adaptive expertise where the domain and innovative skills dimensions are presented as the bread slices and the metacognitive skill as the filler of a sandwich.

However, further research is warranted to examine whether functions of metacognition such as time allocation, development of representations, selection of strategies and monitoring are contributing to the adaptive expertise and also whether the domain skill dimension and metacognition are complementary, not mutually exclusive. The positive influence of adaptive expertise and its dimensions (domain and innovative skills) on perceived work performance and academic ranking indicates the importance of the development of adaptive expertise among university teachers.

5.5 Strengths and Limitations

It is reasonable to speculate that the study sample was representative of university teachers with regard to their age, gender, academic rank and experience (Table 4). However, the sample size was small due to inadequate response rate. The poor response rate may be due to the short duration (less than a month) of the data collection period. However, the measure of sampling adequacy using KMO and Bartlett's Test of Sphericity indicated that the sample size was adequate for valid statistical data analysis (Table 5). Model fit indices obtained from CFA indicated that a good fitting model which was consistent with the present data was achieved. As the best fit model was selected after having compared the model fit indices of three models (Table 12), it is reasonable to state that the selected model is plausible for the interpretation of results reasonably well (Schermelleh-Engel, Moosbrugger, & Müller, 2003).

Although the present study revealed important information regarding adaptive expertise of university teachers, there are a number of limitations in the study. The biggest limitation is the small sample size and inadequate representations from different categories of university teachers. Therefore, further study using a bigger sample drawn from different faculties is highly recommended.

The present study calculated the perceived work performance using three questions and it cannot be considered as a strong measurement of perceived work performance. Furthermore, it is only the perceived performance by the respondents and real work output was not established by other means. Therefore, caution is required when making generalisations from the present results.

The present study followed the same tool and almost similar calculation method used in the study of Carbonell et al. (2016). This could be another reason for reproduction of the same findings as reported by Carbonell et al. (2016). Therefore, studies of measuring adaptive expertise of university teachers using different tools are helpful to bring definitive answers to the research questions.

5.6 Conclusions, Recommendations & Future Research

To my knowledge, there is no evidence of any research which studied adaptive expertise among university teachers. The present study for the first time identified two main dimensions of adaptive expertise among university teachers, namely domain skill and innovative skill. It is a reconfirmation of a similar finding reported for some other populations. The domain skill dimension showed a strong relationship with adaptive expertise of university teachers. This study could not confirm that metacognitive skill is a dimension of adaptive expertise of university teachers. However, section 5.1 discussed the importance of metacognition for adaptive expertise suggesting improvements to the measuring tool by inclusion of new items which can comprehend the important aspects of metacognition described by Sternberg (2001).

An interesting finding of this study was a significant relationship between adaptive expertise and perceived work performance during the COVID-19 pandemic which points to the need for the professional development programmes promoting adaptive expertise among university teachers. Furthermore, a positive correlation between adaptive expertise and academic ranks and the absence of any relationship with one's experience and age indicate that adaptive expertise is not acquired automatically and should be developed intentionally.

The findings of this study can be used to make a few recommendations. Firstly, it prompts several new research questions. Studying of the contribution of metacognition functions which has not yet been investigated to the adaptive expertise by inclusion of new items is recommended. These items should focus on capturing metacognitive aspects such as time allocation, development of representations, selection of strategies and monitoring, as they convey attributes beyond a meaning of "knowing about knowing or knowing that one knows". The relationship between academic ranks and adaptive expertise also warrant further research as this might

reveal some important information for improving adaptive expertise among university teachers.

Secondly, this study showed that investments for the development of adaptive expertise among university teachers would have promising results as a positive relationship was shown between adaptive expertise and perceived work performance. Further, it is suggestive that these development programmes should consider the participation of members irrespective of their age and experience as age and experience did not show any relationship to adaptive expertise of university teachers.

Thirdly, this study provides important details about the validity of the tool developed by Carbonell et al. (2016) as a subjective measuring tool for adaptive expertise by analysing its 17 items with suggestions for further improvement and items which could be dropped. Therefore, an improved measuring tool could be used for the identification of the status of different dimensions of adaptive expertise among university teachers which can be used for staff development programmes.

CHAPTER 6

6. References

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ANNEXURES

Annexure 1 – Page1

Tool for measuring adaptive expertise

Item 1: I realized that I need to learn continuously to become and stay an expert in my field.

Item 2: I realized that knowledge in my discipline keeps on developing.

Item 3: I gained a better understanding of concepts in my discipline.

Item 4: I was able to indicate the cause of any obstacles which emerged.

Item 5: I concerned myself with the latest development in the domain of my discipline.

Item 6: I showed that I am willing to keep on learning new aspects related to my discipline.

Item 7: I was able to develop and integrate new knowledge with what I learned in the past.

Item 8: I focused on new challenges in my academic environment.

Item 9: I approached new tasks/projects in similar ways as I worked in the past.

Item 10: I sought out feedback.

Item 11: I was able to keep on performing at a high level when confronted with unfamiliar situations or tasks.

Item 12: I was able to apply my knowledge flexible to the different tasks in my academic environment.

Item 13: I was able to assess when my knowledge is insufficient to perform a specific task or solve a particular problem.

Item 14: I was able to assess what skills I do not possess to perform a certain/specific task or solve a particular problem.

Item 15: I applied my knowledge in new and unfamiliar situations in areas related to my discipline with a degree of success.

Item 16: I was able to adapt my work habits to the needs of the situation.

Item 17: When I was confronted with obstacles or difficult situations, I gave up.

Annexure 1 – Page2

Gender

Male	Female	Do not reveal
○	○	○

Age

Field of teaching expertise

Present academic position

Working experience at the present position

Annexure 1 – Page 3

"I realized that I need to learn continuously to become and stay an expert in my field."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I realized that knowledge in my discipline keeps on developing."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I gained a better understanding of concepts in my discipline."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I was able to indicate the cause of any obstacles which emerged."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I concerned myself with the latest development in the domain of my discipline."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I showed that I am willing to keep on learning new aspects related to my discipline."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

"I was able to develop and integrate new knowledge with what I learned in the past."
Select the most appropriate response for you using the following key.

- It is never or only rarely true of me
- It is sometimes true of me
- It is true of me about half the time
- It is frequently true of me
- It is always or almost always true of me

Annexure 1 – Page 4

"I focused on new challenges in my academic environment."
Select the most appropriate response for you using the following key.

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I approached new tasks/projects in similar ways as I worked in the past."
Select the most appropriate response for you using the following key.

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I sought out feedback."
Select the most appropriate response for you using the following key.

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I was able to keep on performing at a high level when confronted with unfamiliar situations or tasks."
Select the most appropriate response for you using the following key.

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I was able to apply my knowledge flexible to the different tasks in my academic environment."
Select the most appropriate response for you using the following key.

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

Annexure 1 – Page 5

"I was able to assess when my knowledge is insufficient to perform a specific task or solve a particular problem."
Select the most appropriate response for you using the following key:

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I was able to assess what skills I do not possess to perform a certain/specific task or solve a particular problem."
Select the most appropriate response for you using the following key:

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I applied my knowledge in new and unfamiliar situations in areas related to my discipline with a degree of success."
Select the most appropriate response for you using the following key:

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"I was able to adapt my work habits to the needs of the situation."
Select the most appropriate response for you using the following key:

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

"When I was confronted with obstacles or difficult situations, I gave up."
Select the most appropriate response for you using the following key:

- ○ It is never or only rarely true of me
- ○ It is sometimes true of me
- ○ It is true of me about half the time
- ○ It is frequently true of me
- ○ It is always or almost always true of me

Annexure 1 – Page 6

Next three questions are related to your work performance and modified teaching methods implemented during the altered academic environment. Please select the appropriate number from the scale between 1-10 regarding your perceived performance levels.

How do you appraise your work performance during the altered academic environment?

Extremely bad — Extremely good

0 1 2 3 4 5 6 7 8 9 10

How satisfied are you with the amount of work you have completed?

Extremely bad — Extremely good

0 1 2 3 4 5 6 7 8 9 10

How satisfied are you with the quality of the teaching you have completed?

Extremely bad — Extremely good

0 1 2 3 4 5 6 7 8 9 10

What is the approximate number of face to face teaching sessions that you were supposed to deliver since the closing of the UT till mid of May 2020? (according to the agenda)

What is the number of intended teaching sessions that you were unable to complete in the online environment during the above mentioned period?

→

Annexure 2 – Page 1

Table 6

Mean and Median Scores of Items of Three Dimensions

Item no		*N*	Median	*M*	*(SD)*
	Domain				
1	I realized that I need to learn continuously to become and stay an expert in my field	40	5.00	4.38	0.98
2	I realized that knowledge in my discipline keeps on developing	40	5.00	4.5	0.64
3	I gained a better understanding of concepts in my discipline	40	4.00	4.35	0.70
5	I concerned myself with the latest development in the domain of my discipline	40	4.00	3.83	0.98
7	I was able to develop and integrate new knowledge with what I learned in the past	40	4.00	4.28	0.56
	Total for domain dimension	40		4.26	0.60
	Innovative				
6	I showed that I am willing to keep on learning new aspects related to my discipline	40	4.50	4.25	0.90
8	I focused on new challenges in my academic environment	40	4.00	4.08	0.76
9	I approached new tasks/projects in similar ways as I worked in the past	40	3.00	2.53	0.99

11	I was able to keep on performing at a high level when confronted with unfamiliar situations or tasks	40	4.00	3.83	0.75
12	I was able to apply my knowledge flexibly to the different tasks in my academic environment	40	4.00	3.98	0.58
15	I applied my knowledge in new and unfamiliar situations in areas related to my discipline with a degree of success	40	4.00	3.85	0.53
16	I was able to adapt my work habits to the needs of the situation	40	4.00	4.05	0.64
17	When I was confronted with obstacles or difficult situations, I gave up	40	5.00	4.42	0.78
	Total for innovative dimension	40		3.87	0.34
	Metacognitive				
4	I was able to indicate the cause of any obstacles which emerged	40	4.00	3.95	0.50
10	I sought out feedback	40	4.00	3.75	0.840
13	I was able to assess when my knowledge is insufficient to perform a specific task or solve a particular problem	40	4.00	3.83	0.594
14	I was able to assess what skills I do not possess to perform a certain/specific task or solve a particular problem	40	4.00	3.85	0.622
	Total of metacognitive dimension	40		3.84	0.34

Annexure 3

Table 7

Anderson-Darling Normality Test Results

Item No	Statistic	p value	Normality
1	5.0781	<0.001	No
2	5.1442	<0.001	No
3	4.0934	<0.001	No
4	6.7761	<0.001	No
5	2.2615	<0.001	No
6	3.5689	<0.001	No
7	5.8155	<0.001	No
8	4.2641	<0.001	No
9	1.8075	<0.001	No
10	2.4038	<0.001	No
11	3.4013	<0.001	No
12	5.1719	<0.001	No
13	4.8284	<0.001	No
14	4.3514	<0.001	No
15	7.5585	<0.001	No
16	4.1031	<0.001	No
17	4.5879	<0.001	No

Annexure 4

Table 11

Factor Structure of Adaptive Expertise using EFA

Item no	Component		
	1	2	3
6	0.851		
1	0.834		
7	0.822		
3	0.809		
8	0.736		
5	0.702		
2	0.591		
11		0.799	
10		0.691	
15		0.538	
4		0.520	
9		-0.429	
16			
17			
13			0.867
14			0.832
12		0.459	0.629

Note. Extraction Method & Rotation: Principal Component Analysis and Direct Oblimin Rotation.