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The Epistemic Beliefs of Novice and Expert College Professors

by

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Croyances épistémiques des professeurs novices et experts des collèges

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SUMMARY

Previous research has demonstrated that when teachers have sophisticated epistemic beliefs, they are more likely to adopt constructivist teaching beliefs and behaviours. In order to explore the belief sophistication of teachers, the goal of the current research is to compare different types of experiences common to CEGEP professors, and determine whether any are associated with the sophistication of a professor's epistemic beliefs.

In surveying CEGEP professors from Heritage College (35 responses), the data demonstrated no association of statistical significance between the sophistication of one's epistemic beliefs and how many years a person has taught in the classroom. It also found that while content knowledge (CK) experts hold sophisticated beliefs about the source and authority of knowledge, at the same time, CK experts are very unlikely to use modern pedagogical techniques such as flexible student grouping practices. The findings also noted an odd juxtaposition; while pedagogical content knowledge (PCK) experts hold sophisticated beliefs regarding the rejection of the IT/TF model, it was also demonstrated that PCK experts hold very naïve epistemic beliefs regarding the idea that learning takes effort/ that it is a process. Finally, those who were full time professionals for a minimum of five years prior to becoming teachers were found to be willing to adopt constructivist teaching techniques such as flexible grouping practices.

Key words: CONSTRUCTIVISM, EDUCATION REFORM, EPISTEMOLOGY, EPISTEMIC BELIEFS, COLLEGE TEACHERS, PERRY, SCHOMMER

RÉSUMÉ

L'adoption et la mise en œuvre du paradigme pédagogique du constructivisme est le principal objectif pédagogique des réformes de l'éducation moderne. Pour que ce pendule pédagogique s'éloigne de l'approche didactique axée sur le transfert d'informations / l'enseignant (IT/TF) et adopte l'approche d'apprentissage moderne centrée sur l'étudiant du modèle constructiviste. Malgré plus de deux décennies de recommandations pédagogiques fondées sur des preuves, les environnements d'enseignement et d'apprentissage modernes sont restés relativement inchangés depuis des centaines d'années, en particulier dans l'enseignement supérieur. En effet, depuis plus de trente ans, les experts pédagogiques déplorent les problèmes de l'approche transfert d'information/centrée sur l'enseignant. Pourtant, le modèle académique qui continue d'exister dans la plupart des environnements éducatifs continue d'être exécuté par l'enseignant « sage sur scène ». Cela soulève la question suivante: pourquoi le modèle d'éducation est-il resté inébranlable face à tout changement majeur? Pourquoi tant d'enseignants ont-ils tendance à répéter les erreurs du passé? Qu'en est-il des enseignants qui s'efforcent d'adopter des modèles d'enseignement modernes, qu'est-ce qui les rend uniques?

Des recherches antérieures ont démontré que les enseignants qui ont des croyances épistémiques sophistiquées adoptent des comportements d'enseignement constructivistes. Le but de la recherche actuelle est de déterminer s'il existe des types spécifiques d'expérience des enseignants qui sont positivement associés à la sophistication des croyances épistémiques. Les types d'expérience des enseignants analysés étaient les suivants: combien d'années d'expérience en classe une personne

possède-t-elle; quelle éducation ils ont dans le domaine qu'ils enseignent (connaissance du contenu); la quantité de connaissances pédagogiques dont dispose la personne; et enfin, s'ils avaient une quelconque expérience de travail pertinente sur le terrain avant de devenir enseignants (par exemple, un psychologue qui, après un minimum de cinq ans de travail en tant que thérapeute, est passé à l'enseignement de la psychologie). L'hypothèse était qu'au moins certains de ces différents types d'expérience des enseignants pourraient être positivement associés à la sophistication des croyances épistémiques.

Les actions sont guidées par la croyance. Les recommandations d'actions ne seront pas autogénérées si la personne ne croit pas que les recommandations fonctionneront. Changez les croyances de la personne et vous pourriez l'amener à changer ses actions. À cette fin, des recherches antérieures ont montré que les enseignants ayant des croyances épistémiques sophistiquées adoptent des comportements d'enseignement constructivistes. Dans l'espoir d'amener plus de gens au constructivisme, il est important que nous apprenions comment des croyances épistémiques et pédagogiques sophistiquées en viennent à être acquises. Si nous pouvons le savoir, nous pourrons peut-être apprendre à augmenter la sophistication des croyances épistémiques de nos enseignants et, en retour, avoir un plus grand taux de réussite chez les enseignants qui adoptent l'approche constructiviste.

L'objectif de la présente étude est de déterminer s'il existe un type spécifique d'expertise en enseignement qui sont positivement associés à la sophistication des croyances épistémiques. L'expertise des enseignants a été définie de quatre manières différentes: la durée pendant laquelle une personne a enseigné en classe, son niveau d'éducation en rapport avec le domaine qu'elle enseigne (connaissance du contenu); la

quantité de connaissances pédagogiques dont dispose la personne; et enfin, s'ils avaient une expérience professionnelle pertinente dans le domaine avant de devenir enseignant (par exemple, un psychologue qui, après un minimum de cinq ans de travail comme thérapeute, est passé à l'enseignement de la psychologie). L'hypothèse était qu'au moins certains de ces différents types d'expertise des enseignants seraient positivement associés à la sophistication des croyances épistémiques.

Les croyances épistémiques sont des croyances sur l'apprentissage et la connaissance. Perry (1968, 1970) a été l'une des premières personnes à écrire sur le développement des croyances épistémiques. Bien qu'il existe différents types de croyances épistémiques, Perry a soutenu qu'elles sont interdépendantes de sorte qu'à mesure qu'une croyance grandit et devient plus sophistiquée, d'autres croyances épistémiques le feront aussi. En revanche, Schommer (1990) a soutenu que les domaines épistémiques sont indépendants les uns des autres et que l'on peut avoir des croyances épistémiques à la fois naïves et sophistiquées. En 1990, Schommer a développé un questionnaire de Likert pour mesurer si un répondant avait des croyances naïves ou sophistiquées dans sept domaines de croyances épistémiques. La présente étude utilise une adaptation de cette enquête Likert. Des études ont montré que les croyances épistémologiques personnelles influencent les opérations cognitives et métacognitives. Ils influencent également la façon dont les enseignants conceptualisent l'enseignement.

Cela peut être vu par exemple dans King & Kitchener (1994), qui ont constaté qu'un individu avec des croyances épistémologiques sophistiquées est fonctionnellement meilleur à comprendre la nature d'un problème sur la base des preuves disponibles. Ils sont également plus susceptibles de croire que des solutions alternatives peuvent être

élaborées pour résoudre les problèmes. En revanche, les individus ayant des croyances épistémologiques naïves croient généralement que la connaissance est passive. Faisant écho à ces idées, Schommer-Aikins (2005) a démontré que les individus ayant des croyances sophistiquées sont capables de se rapporter aux experts sur un plan plus niveau, et ils sont également plus susceptibles de supposer que les connaissances proviennent de preuves empiriques et de la raison. Maravilla & Gomez (2015) ont résumé les domaines épistémiques de Schommer: Lorsque nous considérons la capacité d'une personne à apprendre, la croyance naïve est que l'apprentissage est quelque chose qui est fixé à la naissance, une croyance épistémique plus sophistiquée serait que la capacité d'apprendre peut changer avec le temps. Dans sa forme la plus simple, la croyance épistémique sur la structure de la connaissance est que la connaissance est isolée et produite sans ambiguïté, dans sa forme la plus sophistiquée, que la connaissance est l'interrelation d'idées conceptuelles, parfois avec ambiguïté. Les pôles de la catégorie sur la vitesse d'apprentissage sont qu'il se fait soit rapidement et en une seule étape (simple), soit que l'apprentissage se fait progressivement au fil du temps (sophistiqué). Enfin, la croyance épistémique au sujet de la certitude de la connaissance est que la connaissance est absolue et immuable (simple), ou que la connaissance est relative - quelque chose qui change et évolue (sophistiqué).

À l'automne 2017, les professeurs du cégep du Collège Héritage (environ 200) ont reçu trois courriels. Ces e-mails étaient les mêmes, ils expliquaient la raison de l'e-mail et le but de l'étude. Si le professeur choisissait de participer à l'étude, il pouvait cliquer sur un lien qui le mènerait à la plate-forme *Survey Monkey* où le professeur pourrait remplir le sondage de manière anonyme. Le questionnaire posait aux répondants des

questions qui aideraient à déchiffrer les caractéristiques démographiques de l'individu, telles que: le sexe, le niveau d'éducation, l'expérience de travail antérieure, la discipline enseignée. On leur a ensuite demandé de remplir une adaptation du questionnaire Likert de Schommer (1990). Les répondants ont classé la force de leurs croyances de 1 à 100 pour 53 déclarations. Les 53 déclarations de croyances représentaient les sept domaines de croyances épistémiques (et pédagogiques) de Schommer: #1- La croyance que la connaissance est innée / est fixée à la naissance (score élevé : croyance naïve); #2- La croyance que l'apprentissage nécessite des efforts / est un processus (score élevé: croyance sophistiquée); #3- Croyances concernant les experts et l'autorité (score élevé : croyance naïve); #4- Approbation de l'approche pédagogique IT/TF (score élevé : croyance naïve); #5- Approbation de l'approche pédagogique constructiviste (score élevé : croyance sophistiquée); #6- L'utilisation d'un enseignement ciblé (score élevé : croyance sophistiquée); et enfin, #7- L'utilisation d'une pratique de regroupement flexible (score élevé : croyance sophistiquée). Afin de déterminer la qualité de la croyance du répondant, la moyenne numérique a été trouvée pour chaque groupe d'énoncés de domaine. Les moyennes de classement ont été divisées en trois sections 0-33,3 % (croyance naïve), 33,4-66,6 % (moyenne) et 66,7-100 % (croyance sophistiqué). Les résultats des domaines épistémiques #1, #3 et #4 ont tous été inversés pour s'adapter aux tableaux de données suivants.

À partir de l'échantillon de 35 enseignants, les résultats étaient que, comme le soutient Schommer (1990), les sept domaines épistémiques étaient indépendants les uns des autres. Il était possible que les enseignants aient des croyances épistémiques à la fois naïves et sophistiquées. Dans un sondage auprès de professeurs de cégep à l'Héritage

Collège, les données ont montré qu'il n'y avait aucune signification statistique entre la sophistication de ses croyances épistémiques et le nombre d'années qu'ils ont enseigné en classe. Cela signifie que sans incitation supplémentaire, les croyances épistémiques d'un enseignant ne deviendront pas plus sophistiquées avec le temps. Les données ont également révélé que, bien que les experts de la connaissance du contenu (ceux qui détiennent un doctorat) ont des croyances sophistiquées concernant les experts et l'autorité (la source de la connaissance). Cependant, dans le même temps, il a été constaté que les experts de Content Knowledge ont des croyances épistémiques naïves en général, montrant leur préférence pour l'approche axée sur le transfert d'informations / l'enseignant (IT / TF). En outre, les données ont également montré qu'il est très peu probable que les experts en connaissance du contenu utilisent des techniques pédagogiques telles que des pratiques de regroupement flexibles. Contrairement aux experts de la connaissance du contenu, il a été démontré que les experts du contenu pédagogique (PCK) ont des croyances sophistiquées sur le rejet du modèle IT / TF. Déroutantes, les données ont également montré que les experts PCK ont des croyances épistémiques très naïves sur l'idée que l'apprentissage demande des efforts / que c'est un processus. Enfin, ceux qui ont été des professionnels à temps plein pendant au moins cinq ans avant de devenir enseignants se sont révélés disposés à adopter des techniques d'enseignement telles que le regroupement flexible.

L'essentiel est que si nous voulons rompre avec les paradigmes d'enseignement IT / FT, nous devons trouver des moyens d'augmenter la sophistication des croyances épistémiques et pédagogiques de notre enseignant. Cela peut impliquer de reconsidérer la façon dont nous envisageons l'enseignant expert. Nous devons cesser d'utiliser

l'expérience en classe d'un enseignant et le niveau de sa connaissance du contenu comme marqueurs d'excellence dans l'enseignement. En effet, le profil conceptuel d'un enseignant expert pourrait avoir besoin de voir un atout vital, le rôle de l'expérience professionnelle du monde réel. Nous avons longtemps entendu l'expression « ceux qui ne peuvent pas enseigner ». Il y a peut-être une part de vérité là-dedans. Peut-être que la définition limitée de l'enseignant qui existe (la forme platonicienne si vous voulez) est la raison même pour laquelle nous n'avons pas vu de réels progrès dans les réformes de l'éducation pour abandonner le modèle IT/TF en échange du modèle constructiviste. Une partie de la solution consiste peut-être à redéfinir ce que signifie être un enseignant expert, et nous ne le faisons pas en embauchant des enseignants ou des étudiants qui ont passé tout leur temps en classe, mais plutôt, nous recherchons des personnes qui ont de nombreuses expériences en dehors de la classe. Ceux qui peuvent créer des opportunités d'apprentissage authentiques basées sur la résolution de problèmes et le traitement de vrais problèmes.

Mots Cles: ÉPISTEMOLOGIE ÉPISTÉMIQUES CROYANCES ÉPISTÈMES ENSEIGNANTS PERRY SCHOMMER

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List of Abbreviations, Initialisms, and Acronyms

Abbreviation	Unabbreviated	Meaning	Meaning
ACK	**Apprentice Content Knowledge**	**Novice** No relevant work experience	**Expert** Minimum five years of full-time employment in the professional field relevant to content currently teaching
AR	**ALL Respondents**		
CK	**Content Knowledge**	**Novice** Maximum two bachelor's degrees relevant to the content current teaching	**Expert** PhD relevant to the content current teaching
IT/TF	**Information Transfer/ Teacher Focused**	Type of teaching model where learning is seen as information memorizing and teacher's focus is on themselves rather than the student.	
N/E	**Novice/ Expert**		
PCK	**Pedagogical Content Knowledge**	**Novice** Maximum mandatory PD Days held by employer	**Expert** Minimum a certificate in a program such as the MTP
YTE	**Years of Teaching Experience**	**Novice** Novice: 6 years or less of classroom experience	**Expert** 13 years or more of classroom experience

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** Indicates Coding Inversion.

INTRODUCTION

The adoption and implementation of the constructivist teaching paradigm is the main pedagogical objective of modern education reforms (Barr, R., & Tagg, J., 1995, p.13). For this pedagogic pendulum to swing, we need our teachers to abandon the old didactic information-transfer / teacher focused (IT/TF) approach, and instead, adopt the modern student-centered learning approach of the constructivist model.

For over thirty years pedagogical experts have been lamenting the "sage on the stage", information-transfer / teacher focused (IT/TF) approach to learning. Though this movement comes with ample evidence that shows why simply lecturing to students is insufficient, the IT/TF model is still prevalent, especially in higher education. Previous research has shown that teachers with sophisticated epistemic beliefs are likely to adopt the newer constructivist teaching approach, and, that teachers who hold simple or naïve epistemic beliefs are likely to use the outdated IT/TF model (Brownlee, J., & Berthelsen, D. (2005); Hofer, B. (2001); Schommer-Aikins, Duell, O. K., Hutter, R. (2005)).

The corollary is that we need to find out how we can improve the sophistication of our teacher's epistemic beliefs. Using a Likert style questionnaire based on the one developed Schommer (1994), and adapted by Lee, J., Zhang, Z., Song, H., & Huang, X. (2013), the current study looks to see whether there exists specific experiences that predict whether a teacher will hold sophisticated epistemic beliefs. It does so by asking whether the expertise that comes from: years of classroom teaching, content knowledge, pedagogical content knowledge, or, previous professional/ apprentice work, have any association with the sophistication of one's epistemic beliefs.

The findings of this study are that years of classroom teaching experience have no impact on the sophistication of one's epistemic beliefs. Content knowledge expertise is positively associated with epistemically sophisticated ideas of where knowledge comes from, the role of experts, and the legitimacy of challenging authority. However, content knowledge experts are also the most likely to continue to use the IT/TF model, and, are unwilling to try new pedagogical techniques such as the use of flexible student grouping practices. By contrast, pedagogical content knowledge experts are most likely to denounce the IT/TF model; yet at the same time, they also hold very naive epistemic beliefs regarding how learning occurs over time i.e., the progress of learning. Finally, the study found that those individuals who had full time professional jobs for a minimum of five years prior to becoming teachers are the most likely to use new teaching strategies such as the use of flexible student grouping practices.

Taken as a whole, the findings reject the intuitive idea that the best teachers are those who are seasoned veterans with ample content knowledge, and instead points to a new idea: that previous professional work experience can shape one's epistemic beliefs such that when one takes on the role of teacher, they are better able to create an authentic and meaningful learning environment. Professional apprentice knowledge can be used to enhance epistemic beliefs, which in turn, will lead to thoughtful pedagogical strategies based on real world problem solving techniques.

CHAPTER ONE

STATEMENT OF THE PROBLEM

In summarizing empirical evidence from a variety of international settings, Christopher Knapper (2010) argued that prevailing teaching practices of higher education do not encourage the sort of learning that contemporary society demands. Lamenting the fact that though there is an impressive body of evidence on how new constructivist teaching methods and curriculum can be designed to affect deep, autonomous, and reflective learning, Knapper contends that in higher education, most faculty are largely ignorant of this scholarship. This obliviousness leads to instructional practices and curriculum planning that are dominated by tradition rather than research evidence. As a result, "teaching in higher education remains largely didactic, assessment of student work is often trivial, and curricula are more likely to emphasize content coverage than acquisition of lifelong and life-wide learning skills" (p. 229).

The problem is that there is a proliferation of teachers who, regardless of their content knowledge and years of experience in the classroom, insist on primarily using the traditional lecture as their primary method of teaching. The main epistemic belief of these teachers is the naïve understanding that their role is to "transmit" their own understandings into the minds of their students. The problem with this approach is that it reinforces the idea that teaching is telling as opposed to helping students develop their own understandings of the subject matter. Knapper (2010) ascribed the prevalence of the traditional information-transfer approach to the fact that most faculty model their teaching style upon the uncritical adoption of the model that comes most readily to hand- their own professors. Consequently, it is not surprising that "teaching methods have

remained largely unchanging since medieval times when lectures predominated largely because of the scarcity of printed books" (p. 230).

Over two decades ago, Hanke (1998) argued that when using the traditional information- transfer/ teacher focused (IT/TF) approach, students mastered no more than 30 percent of the key concepts that they didn't already know at the start of the course. One decade ago, Wieman (2007) confirmed that these findings of sub-30 percent gains using the IT/TF approach are seen often, and are largely independent of lecturer quality, class size, and institution. He argued that the consistency of these results clearly demonstrates that the problem is in the basic pedagogical approach: the traditional lecture is simply not successful in helping most students achieve mastery of fundamental concepts. At the same time, the last 35 years of research about pedagogy in higher education has demonstrated the importance of teaching practices that promote more generic skills such as problem solving, critical thinking, and what the researchers have termed "deep" learning (Marton & Säljö, 1976; Biggs & Collis,1982; Marton, Hounsell & Entwistle, 1997). These new constructive models of pedagogical approaches, which involve more interactive engagement with students, have been shown to have consistently higher gains.

Despite this dissonance between classroom teaching and theoretical learning paradigms, which have been known for at least three decades, at present, the problem continues in higher education: how do we encourage teachers of higher education to adopt teaching practices that foster higher level thinking? Knapper (2010) dismally remarked that, under the current system, at least in most of North America, there are few negative consequences if a faculty member opts not to read, study, or participate in any

kind of professional development activity. In this fundamental way, teaching is devalued by the way it is practiced. Moreover, simply assuming that teacher's epistemic and pedagogical beliefs will become more sophisticated with time is not guaranteed. As argued by Tsui (2003a), while experience is undoubtedly a crucial factor, it does not necessarily result in the development of expertise. "There is a familiar saying that states, for some people, eighteen years of experience is one year's experience repeated seventeen times" (p. 13).

It is clear from the literature that teachers' approaches to teaching are directly connected to their personal epistemic beliefs, that is, their beliefs about knowledge and learning. For example, Kuhn and Park (2005) found that sophisticated epistemic beliefs lead to a preference for more constructive styles of teaching and learning. Based on this idea, the current study assumes that the sophistication of one's epistemic beliefs will indicate whether a teacher is more likely to adopt surface or deep teaching practices. Although research has shown that sophisticated epistemic beliefs lead to sophisticated teaching principles, the process of how epistemic beliefs become more complex is not clear.

Due to the fact that IT/TF continues to be prevalent in higher education, years of classroom teaching experience, and content expertise are neither necessary nor sufficient conditions of epistemic belief sophistication. Thus, the specific problem this study seeks to address is to determine whether there are experiential factors that contribute to the development in sophistication of a teacher's epistemic beliefs. That is, whether there are specific achievements teachers ought to strive for (and admin to encourage) in order to increase the likelihood that a teacher's epistemic beliefs will become more sophisticated

and thereby, will become more likely to adopt constructivist teaching approaches? These questions are important because the answers might shed light on the best way for a novice teacher with naive epistemic beliefs to blossom into an expert teacher with sophisticated epistemic beliefs.

The present study seeks to explore the notion of teacher expertise and does so by considering the sophistication of an individual's epistemic beliefs and the experiences they've had (years of classroom teaching, content knowledge, pedagogical content knowledge, and apprentice/ acquired content knowledge). The main idea of the methodological design is that while the level of expertise will fluctuate per person for each of the four experiences, as a whole, the respondent's answers will provide a matrix that can be used to compare the different types of teacher experience and whether being an expert of these experiences predicts the sophistication of the respondent's epistemic beliefs. The hypothesis is that regardless of how we define "teacher expertise", the expert teacher will hold more sophisticated beliefs than their novice counterparts. Furthermore, the results of these observations may be used to determine ways in which a teacher is most likely to increase the sophistication of their epistemic beliefs.

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Conceptual Framework

A few years ago Academic Services asked our Philosophy/ Humanities department to look into our teaching practices, as recently published statistics had demonstrated that we had the lowest overall averages as compared to other humanities departments in English speaking CEGEPs. When this request was presented by our then department head, one of our most senior professors argued against the need for self-reflection, and instead quipped that except for one professor, all the others in the department held doctorates. As such, the problem could not possibly belong to our department with its content knowledge experts, but to *all* the other departments throughout the English CEGEPs, where hiring practices must be "lowering the bar" and accepting teachers whose content knowledge was no higher than a masters in philosophy, and thus as a result, these *other* the departments were teaching "basket-weaving courses".

As the one professor in the department who not only did not hold a PhD, but who also had relatively little teaching experience as compared to other members of the department, this rebuff made me wonder whether having high content knowledge necessarily made one a good teacher? Further, since this comment came from the most senior teacher in the department, it also begged the question whether years of teaching experience automatically translates into teacher expertise? Moreover, if neither content knowledge, nor years of teaching experience made someone an expert teacher, what might? As a student of the Master Teacher Program, a program designed specifically to teach higher education professors the "new" constructivist learning paradigm, I wondered

whether the experience gained by increasing one's pedagogical content knowledge had a better success rate in shaping individuals into expert teachers than did having the experience of either many years of classroom teaching, or, high levels of content knowledge?

These ponderings inevitably led to questions such as: how do we recognize an expert teacher? And, how does one become an expert teacher? Cognitive scientists have studied *what* constitutes expert-competence in many disciplines and they have found a few basic components. According to Bransford, et al. (2000), experts have extensive factual knowledge about their subject; experts have a mental organizational structure that facilitates the retrieval and effective application of their knowledge; finally, experts have an ability to monitor their own thinking in their discipline of expertise. While these findings explain what an expert does, they do not explain how one goes about *becoming* an expert? Are there certain experiences which help facilitate a person's ability to transition from a novice to an expert?

How do teachers conceptualize their role as teachers? How do they imagine the knowledge and information they are to share with their students? How does one recognize that learning has occurred? At their root, these questions are epistemological in nature. Epistemology is a branch of philosophy that investigates the origin, nature, methods, and limits of human knowledge. Such beliefs influence the development of knowledge because they are considered to be the central values or theories that are functionally connected to most other beliefs and knowledge (Hofer & Pintrich, 1997). In writing about epistemic beliefs, Perry (1970) hypothesized that the development of epistemological belief goes through several fixed stages: (a) dualism, (b) multiplism, (c)

relativism, and (d) commitment. Expanding on Perry's work, Schommer (1990) agreed that there are different types of epistemic beliefs, but argued that these beliefs are independent of each other such that one may hold both naïve and sophisticated beliefs at the same time.

Epistemological beliefs regarding knowledge and learning shape a teacher's pedagogical beliefs and subsequently, their actions. Personal epistemological beliefs influence one's cognitive and metacognitive operations and influence how teachers conceptualize teaching. This may be seen for example, in King & Kitchener (1994), who found that an individual with sophisticated epistemological beliefs is functionally better at understanding the nature of an issue on the basis of the available evidence. They are also more likely to believe that alternative solutions may be constructed to solve problems. By contrast, individuals with naive epistemological beliefs usually believe that knowledge is passive. Echoing these ideas, Schommer-Aikins (2005) demonstrated that individuals with sophisticated beliefs are able to relate to experts on a more level plane, and, they are also more likely to assume that knowledge comes from empirical evidence and reason.

As the goal of this study is to look for factors which contribute to the sophistication of a teacher's epistemic beliefs, this study focuses on four types of teacher experience to see whether expertise in that area yields belief sophistication. The four types of experiences are: 1) years of teaching experience (YTE); 2) the level of the teacher's content knowledge (CK); 3) the level of the teacher's pedagogical content knowledge (PCK); and finally 4) the amount of work related, professional / apprentice content knowledge (ACK) the individual has. This study explores whether any of these

experiences predict the development of sophisticated epistemic beliefs by comparing the respondent's experiential background to how they answered epistemic belief statements based on the belief statements first developed by Schommer's (1990, 1994).

Respondents answered an online survey which included a Likert questionnaire asking them to rate the strength of their belief to 53 belief statements. These statements were broken into seven core epistemic and pedagogic beliefs and actions: the certainty of knowledge; the structure of knowledge; the source of knowledge; the speed at which leaning occurs; the improvability of learning; and, the likelihood that the respondent is to use various student-centered activities in their classroom.

Normative beliefs regarding epistemological theory generally agree with the idea that teacher expertise is positively associated with high content knowledge and years of teaching experience, but is this necessarily true? If not, then what factors of expertise ought hiring committees to look for in potential candidates? By examining the epistemic beliefs of teachers with varying degrees of classroom experience, content knowledge, pedagogical content knowledge, and past career experience, we can provide information as to whether epistemological differences exist between these groups. If there are differences, it can shed light on the nature of teacher's epistemic beliefs. As epistemic beliefs predict pedagogical beliefs and actions, the better we can understand a person's epistemic beliefs, the better we can help teachers adopt more modern teaching strategies.

Literature Review

Epistemology. Epistemology is a branch of philosophy concerned with the nature of knowing: its possibility, scope, general basis, and justification of belief (Honderich, 1995). As such, one's personal epistemology is the set of an individual's beliefs about the nature and acquisition of knowledge (Schraw, 2013). Perry (1968) was among the first researchers to investigate personal epistemological beliefs. He interviewed Harvard undergraduates from freshmen to seniors, where he found that freshmen were likely to believe that knowledge is simple, certain, and handed down by authority. By contrast, seniors were likely to believe that knowledge is highly interwoven, fairly tentative, and derived from multiple sources, such as reason and empirical evidence. Since Perry (1968, 1970) began his empirical investigation of epistemological questions, a number of researchers have examined individuals' beliefs about how knowledge is acquired. For example, Schommer (1990) considered the structure of epistemic beliefs; and Hofer & Pintrich (1997) asked how epistemic beliefs influence cognitive and motivational processes?

Schommer (1990) followed Perry in the sense that the philosophical focus of her research was on domain-general epistemological beliefs. Schommer agreed with Perry's theory that epistemic beliefs should be viewed as comprising different epistemic domains or categories: the certainty of knowledge, the structure of knowledge, the source of knowledge, the speed at which leaning occurs, and the improvability of learning (Schommer-Aikins, et al, 2015). However, whereas Perry (1970) argued that these epistemic beliefs are dependent on each other, in that growth or sophistication of one epistemic belief domain means that the other types of epistemic beliefs also become more

sophisticated, Schommer (1990) by contrast theorized that the complexity of epistemological beliefs could not be accounted for with the assumption of an over-arching single epistemic belief. Schommer argued instead that these are "independent" epistemic beliefs; as they are autonomous, they do not progress in a sequential or linear manner, and that "the depth of a person's distinct epistemic beliefs could range from naïve/simple to sophisticated/ complex at the same time" (Manu, Osei-Bonsu, & Atta, 2015, p. 142). Schommer (1990) moved away from Perry's developmental and unidimensional model of epistemic beliefs and instead conceptualized a system of more or less independent epistemic beliefs.

Schommer (1994) eventually presented four independent epistemic categories with which she rendered an account of the nature of epistemological beliefs: the structure and certainty of knowledge, the source of knowledge, and, the ability and speed of learning. In philosophical terms, a naïve epistemic belief regarding the structure and certainty of knowledge is to believe that knowledge is comprised of absolute, unchanging, isolated facts which are produced with no ambiguity. By contrast, the more sophisticated belief is that knowledge is relative and that it evolves and changes. Moreover, it is not merely a set of isolated facts, but rather the interrelation of conceptual ideas, sometimes with ambiguity. People with naïve epistemic beliefs believe that these isolated, undoubtable facts are true because they come from authority. They also have a hard time moderating the strength of their epistemic belief to match available evidence and expert opinion. A person with sophisticated epistemic belief understands the proper use of evidence, how to recognize expertise, and, that there is legitimacy in questioning or challenging that authority. Considering a person's ability and speed of learning, the

naive belief is that learning is something that is fixed at birth and inborn; believing that learning either happens quickly and all at once, or not at all. The sophisticated epistemic belief is to understand that knowledge is continuously evolving and self-constructed; that the ability to learn is a process that takes effort, and, that ability can change over time (Schommer, 1990; 1994; Lee, J., et al, 2013; Maravilla & Gomez, 2015).

Novices and experts. When considering the oscillation of the sophistication of epistemic beliefs, one common comparison has been between experts and novices. Indeed, Bransford, Brown, and Pellegrino (2000), made the argument that there is a primary difference between how experts and novices think about their subject matter. They found that experts notice features and meaningful patterns of information that are unseen by novices; and "that experts are those who have not only acquired a great deal of content knowledge but also, that this content knowledge is organized in ways that reflect a deep understanding of their subject matter" (p. 31).

This finding is echoed in Berliner (1994, 2001), who listed epistemic differences of novice and expert teachers: Expert teachers often develop automaticity and routinization for the repetitive operations that are needed to accomplish their goals; expert teachers are more sensitive to the task demands and social situation when solving pedagogical problems; expert teachers create of more opportunities of learning and are more flexible in their teaching than are novices; expert teachers represent problems in qualitatively different ways than do novices; expert teachers have fast and accurate pattern-recognition capabilities, whereas novices cannot always make sense of what they experience; expert teachers perceive meaningful patterns in the domain in which they are experienced; and, although expert teachers may begin to solve problems slower, they

bring richer and more personal sources of information to bear on the problem they are trying to solve.

In writing about the difference between the way novice and experts think about their discipline, Bransford et al. (2000) found that experts' abilities to reason and solve problems depend on "well-organized knowledge that affects what they notice and how they represent problems... Experts are more likely to recognize meaningful patterns of information" (p. 48). Kirschner (2009) summarized the findings of Donovan et al. (1999) who also noted that experts attend to and notice more important features or, meaningful patterns of information, in a problem or situation than do novices. Donovan claimed that this variation in attending is most probably due to the fact that experts have a great deal of accessible content knowledge organized to reflect deep understanding of the subject matter. Another difference is that expert's knowledge is not simply reducible to sets of isolated facts or propositions, but reflects "contexts of applicability" of that knowledge (Kirshner, 2009, p. 147-148). Moreover, experts have been shown to be able to better represent problems by using deep, structural features (e.g., the requisite analysis needed to solve a problem, underlying principles), whereas novices primarily rely on surface features (e.g., story characteristics, superficial causes) (Hogan et al, 2003, p. 236).

In summarizing the characteristics of novice and expert teachers, Tsui (2003b) notes that most of the studies compare the cognitive process of expert and novice teachers, looking mainly at the teacher's planning in the pre-active phase and teacher thinking and decision making in the interactive phase. In general, expert teachers are more efficient in planning and more selective in information processing. They are better able to recognize meaningful patterns quickly. They demonstrate more autonomy and

flexibility in both planning and teaching. Because they have a large repertoire of routines on which to rely, they are able to improvise and respond to the needs of the students and the situation very quickly. The automaticity that is made possible by the availability of these routines allows them to direct their attention to more important information. Similar to experts in other domains, these characteristics of their "cognitive processes are very much related to their sophisticated knowledge schemata and knowledge base" (p. 41).

It seems that there is an argument to be made that novices in a field hold what Perry and Schommer would deem to be naïve epistemic beliefs, and, that experts hold sophisticated epistemic beliefs about their field. It is observations such as these that beg the pedagogical research question as to whether these arguments can be made when we compare the epistemic beliefs of novice and expert teachers.

Teaching and one's personal epistemic beliefs. The question of how epistemic beliefs shape teaching practice is not a new one. Hofer and Pintrich (1997) and Hofer (2001) claimed that beliefs about the nature of knowledge and its acquisition must be considered individual theories that give rise to one another. Accordingly, these authors claim that pedagogical beliefs are derived from the teacher's epistemological beliefs (Maravilla & Gomez, 2015). Furthering this idea, Hofer (2004) emphasized that a component of effective teaching is for faculty to filter their perceptions of instructional practice through their epistemological assumptions.

In writing about how one's personal epistemic beliefs shape one's pedagogical beliefs, Arredono and Rucinski (1996) found that teachers with more sophisticated or relativistic beliefs tend to be more democratic, empathetic, innovative, and able to use

more teaching strategies. Further, White (2000) found that pre-service teachers with naïve epistemological beliefs tended to have a simplistic view of classroom problems while pre-service teachers with more sophisticated epistemological beliefs were more likely to see complexity in classroom problems and seek-out alternative viewpoints. Finally, Brownlee et al, (2003) noted that teachers with relativistic beliefs were more able to conceive of teaching as facilitating rather than transmitting knowledge.

When they examined how teachers think about the classroom while planning instructional strategies (lesson planning), Housner & Griffey (1985) found that novice teachers tend to regard the class as a whole. That is, novice teachers do not think about the individual students, rather, they think in terms of "a class" of 35 (or so) students. By contrast, expert teachers perceive the classroom as comprising unique individuals. They also found that expert teachers asked more questions about both the students and available teaching equipment prior to lesson planning. Experienced teachers were also able to come up with twice the number of strategies to teach a specific skill than did novice teachers (in Hogan et al, 2003, p. 237).

After reviewing numerous teacher expert-novice comparative studies, Hogan, Rabinowitz, and Craven, (2003), argued that specific differences exist within the areas of planning, instruction, and perceiving and reflecting on classroom events. Specifically, experts planned for the long term and were cognizant of the relationship between daily objectives and the overall curriculum, whereas novices focused on short-term planning. Novices mentally script each section of their lesson, from the questions posed to students to the examples that could be used as conceptual reinforcement. Experts plan more strategies to teach a specific skill than novices, and could implement their lesson largely

unrehearsed prior to the instructional period (p. 240). Hogan et al, also found that experts made more transitions among teaching activities than did novices, were more efficient in probing for student understandings, and made greater use of guided and monitored practice routines to increase student comprehension as compared with novices. If student comprehension was lacking, expert teachers were able to employ a variety of alternative explanations whereas this ability was unattainable by novices. Experts focused on individual student achievement and adapted their lesson accordingly, whereas novices primarily used the interest level of the class as the cue for altering a lesson. Finally, expert content specialists were more accurate in perceiving classroom events than novices (p. 240).

What does it take to become an expert teacher?

Teaching experience. Probably due to the methodological ease of equating teacher expertise with teacher experience, in much of the previous research "teacher expertise" has been operationally defined as length of time teaching (typically 10 years or more). For example, Standley and Madsend (1991) contrasted novice and expert teachers by considering teachers who had more than 10 years of teaching experience to those who were enrolled in an undergraduate music education course. They found that there is a significant relationship between teaching experience and the ability to accurately perceive and describe interactions and events in the classroom.

Similarly, when looking at the difference of epistemic beliefs of expert and novice teachers, Sabers et al (1991) broke his sample of teachers into three groups: experts, advance beginners, and novices. They found that years of teaching experience increased the likelihood the teacher will adopt a student-focused approach. They found that

teachers who had more years of teaching experience were better able to monitor and interpret classroom events. Sabers argued that this difference was due to the expert teacher being able to better discern the interplay between teacher and student. Lopez (2007) found that for beginning teachers the scores of their students were higher every year during the first 7 years. Their students' scores hit asymptote in about their 7th year of teaching. Scores stayed at that level for about seventeen more years, before showing a small decline during the last few years of a teacher's career.

Furthermore, Clermont and colleagues (1994) used teaching experience as their definition of an expert teacher when they based their sample on the responses of a self-questionnaire which asked teachers to rate their confidence in performing chemical demonstrations in front of a classroom and the average number of demonstrations that took place in their classroom per week. They found that experts were teachers those who performed many chemical demonstrations per week (at least four), and were highly confident in their abilities to demonstrate the core conceptual principles. Clermont, et al. found that experts were able to generate a greater number of alternative demonstrations that could be used to teach the same principle; they could also describe these alternatives in better detail, explaining how the demonstration depicts the abstract concepts. The researchers inferred from their findings that the experts in their study were able to provide more alternatives with better detail because they had a richer and more complex mental representation of the topic than the novices in their group.

Ample classroom experience was also used as a way to compare novice and expert teachers for Housner and Griffey (1985). They found that seasoned teachers were concerned with student understanding and utilizing different strategies to assist

individuals experiencing difficulties. Novice teachers by contrast, tended to cater to the level of class interest and ability as a whole. Novices tended to abandon their lesson plans on the whims of student interest in order to maintain classroom management, regardless of individuals who needed continued practice. When summarizing this study, Hogan et al (2003) argued that this differences was due to the teacher's schema becoming more complex as the teacher evolves from a teacher-centered approach to one that is more student-centered (p. 239).

This argument can also be found in Borko and Livingston (1989), who argued that due to the fact that novice teachers have narrow-curriculum planning, they were far more likely to be easily thrown off track by information that was beyond what was in their detailed script, this led them to provide incorrect information and examples to the students. By contrast, expert teachers kept the lessons on track, reaching goals that were established during planning. In addition, the seasoned teachers were better prepared than the novices to answer student's questions by using specific examples to explain the concepts and were able to achieve a balance between student and teacher-centered discussion (in Hogan, et al, 2003, p. 237). Finally, Gonzalez and Carter (1996) contrasted teachers who had more than 12 years of teaching experience with his or her student teacher. They found that the more experienced teacher was more observant of classroom management; they argued it was due to the expert teacher's elaborate mental framework.

More current research has also argued that there is an association between teacher experience and teaching expertise. Chi (2010) found that there are not many pre-service teachers who have highly developed epistemic beliefs (p.136). Furthermore, Therriault

and Harvey (2013) found that high school teachers changed the sophistication of their epistemological beliefs the more they taught (Maravilla & Gomez, 2015, p.112). While not specifically referring to teacher expertise, Berliner (2001), reminded his readers that not only is expertise specific to a domain, it also is something developed over hundreds and thousands of hours and continues to develop

It is important to note, however, that Berliner did go on to argue that the development of expertise is no linear. "Non-monotonicity's and plateaus occur, which indicates shifts in understanding and stabilization of automaticity" (p. 33). He also pointed out that part of the problem inherent in studying epistemic beliefs is due to definitional difficulties which are "quite prominent in the study of expert teachers" (p. 37). Recently, there have been arguments that beyond years of teaching experience, one's content knowledge and/ or pedagogical content knowledge needs to be considered when discussing expert teachers and their epistemological beliefs. It is with this debate in mind, that the current study looks to wedge apart these variations of "expert" teachers.

Teachers as content experts. Despite the fact that a majority of the studies reviewed classroom experience as a measure of expertise, Hogan, Rabinowtiz, & Craven (2003) are adamant in their claim that this type of experience alone does not equate with expertise in teaching. They argue that although teaching experience may improve perceptual abilities, other criteria must be included for an accurate identification of expert teachers. They found that expert content specialists have a richer and more complex schemas than do content novices. As such, they are able to perceive and recall more subtle classroom events, focus on individual student learning occurring in the classroom, and adjust instructional strategies accordingly. By contrast, content novices hold less

complex schemas, focus on short-term planning, and demonstrate fewer instructional strategies that are linked to the abilities of the class as a whole. Furthermore, the interest of the class toward a given topic has greater influence on the novice's instructional strategies than does student achievement or understanding (p. 238).

Borko and Livingston (1989) found that content novice teachers tend to focus on short-term curriculum development whereas expert content specialists focused on both long-and short-term curriculum development. With a concentration in short-term planning, content novices tend to generate highly scripted and mentally well-rehearsed instructional strategies. By contrast, content expert's curriculum plans (long-term) and lesson plans (short-term), were largely unrehearsed and unscripted. Content experts were able to engage in various tiers of curriculum development including yearly, unit, and daily planning. Additionally, the amount of written planning was kept to a minimum, highlighting the main components of the lesson while the remaining part of the lesson was stored mentally. These mental operations included the timing and pacing of the presentation and the number and types of examples used to teach the concept. By contrast, content novice teachers also incorporated this type of mental planning was very specific, scripted, and rehearsed focus on short-term curriculum goals.

Teachers as pedagogical content experts. Perry and Schommer's models of epistemic beliefs have helped to shape contemporary pedagogical discussions. The argument is that there a correlation between those who have sophisticated epistemic beliefs and those who have sophisticated pedagogical beliefs. One can hear echoes of Perry while reading Barr & Tagg (1995) who, while describing the pedagogical swing of the 90's, compared the Instructional Paradigm as one that "frames learning

atomistically", where learning is seen as understanding parts and building toward a whole. By contrast, they argued that the new Learning Paradigm has framed learning "holistically". Learning is seen as a process that sees the interconnection between parts (p. 16).

Darling-Hammond (2000) claimed that although content knowledge is important to effective teaching, it is pedagogical content knowledge and pedagogical knowledge that exert a stronger influence overall. Fourteen years prior to Darling-Hammond, Shulman (1986) argued that for teachers to be effective, competency must lie within three domains that include content knowledge, pedagogical content knowledge, and pedagogical knowledge. He defined content knowledge as an understanding of the concepts embedded within the domain being taught. Pedagogical content knowledge as the ability to convey one's understandings of the content knowledge through multiple models of teaching for students understanding, comprehension, and achievement. Pedagogical knowledge includes the skills necessary for classroom guidance, including management techniques, effective communication strategies, and the assessment of learning.

The importance of pedagogical content knowledge is seen also in Kinzie (2010), who argued that what faculty choose to emphasize and think becomes important and influences what students do (p. 148). Moreover, it has been argued that teachers who hold relativistic beliefs and who are reflective about their own knowledge are more likely to engage in constructivist practices and seek to develop active teaching and learning partnerships. On the other hand, teachers who hold dualistic beliefs about learning and knowing see knowledge as absolute and certain, and are less likely to seek out new

learning or reflect on their current practices. They are more likely to view teaching and learning as an information-transfer process (in Brownlee & Berthelsen, 2004). In making her argument that teacher's impact student learning and motivation, Hofer (2011) argued that "faculty members … have considerable power in shaping goal approaches within their classrooms" (p. 145).

Pointing to the idea that these distinctions of teacher expertise are not to be dismissed, when specifically trying to define an expert teacher through the lens of pedagogical content expertise, researchers such as Grossman (1985); Hashweh (1987); Sanders, Borko, & Lockhart, (1993); and, Schemp, Manross, Tan & Fincher (1998), all used teacher's curriculum planning and actions in the class as measures of teacher expertise. Hogan et al. (2003) summarized the findings of these studies by stating that when pedagogical content expert teachers are confronted with teaching less familiar subject matter, they may not transfer behaviours characteristic of expert teaching, thereby mirroring a more novice teaching approach (p. 239). It is observations such as this that begs for further investigation. What would we find if we compare different types of "teacher experts" with the sophistication of their epistemic beliefs?

Teachers as professional/ apprentice content experts. There are no studies that consider how previous professional/ apprentice experience impacts a teacher's epistemic beliefs and behaviours. This is not surprising because previous work experience is fairly outside the box when developing a theory of what makes a teacher an expert. In fact, this fourth type of teacher experience was only added to the current study due to the fact that a number of respondents wrote about their previous work experience (e.g. nurses who had become teachers of nursing later in life).

Goals of the Current Study

Previous research has demonstrated that teachers who have sophisticated epistemic beliefs adopt constructivist teaching behaviours. The goal of the current research is to determine whether there exist specific types of teacher experience that are positively associated with holding sophisticated epistemic beliefs. This study uses four types of teacher experience: Years of teaching experience (YTE), content knowledge (CK) expertise, pedagogical content knowledge (PCK) expertise, and previous apprentice content knowledge (ACK) expertise; and compares the novice and experts of each in order to determine whether an expertise in any of these four experiences results the sophistication of the person's epistemic beliefs.

CHAPTER THREE

Research Questions & Methodology

The following chapter considers the general and specific research questions of the study, as well as the methodology that was implemented to carry out the research. It also discusses the sample that was drawn from the target group, and how its characteristics were used for to code the data.

General Research Questions

1. Do various types of teacher experiences lead to an increase in epistemic belief sophistication?
2. By examining four types of teacher experience, this study examines *how* one becomes an expert teacher, i.e. one who holds sophisticated epistemic beliefs?

Specific Research Questions

Specific research question 1: Years of teaching experience (YTE). Is there a difference in the sophistication of epistemic beliefs between teachers with little classroom experience, that is, 6 years or less, when compared to teachers with 13 or more years of classroom experience?

A) The null hypothesis for research question one is that there will be no difference between the two groups.

B) The hypothesis H1: The amount of classroom teaching experience a person has had is (positively) correlated to an increase in the sophistication of their epistemic beliefs ($\alpha \leq 0.05$).

Specific research question 2- Content knowledge (CK). Is there a difference in the sophistication of epistemic beliefs between teachers who have low content knowledge of the material they teach, that is, at most two bachelor's degrees, when compared to teachers who hold a PhD in the field they teach?

A) The null hypothesis of research question two is that there will be no difference between the two groups.
B) The hypothesis H1 for research question two will be that level of content knowledge is (positively) correlated with an increase in the sophistication of a person's epistemic beliefs ($\alpha \leq 0.05$).

Specific research question 3- Pedagogical content knowledge (PCK). Is there a difference in the sophistication of epistemic beliefs between teachers who have low pedagogical content knowledge, that is, those whose pedagogical knowledge is limited to mandatory PD sessions or less, when compared to teachers who hold a certificate or higher in professional development programs such as the MTP?

A) The null hypothesis for research question three is that there will be no difference between the two groups.
B) The hypothesis H1 for research question three is that the level of pedagogical content knowledge a person has will be (positively) correlated to an increase in the sophistication of their epistemic beliefs ($\alpha \leq 0.05$).

Specific research question 4- Apprenticed content knowledge (ACK). Is there is difference in the sophistication of the epistemic beliefs between teachers who have little to no experience applying their content knowledge in real-world, practical, professional experience, as compared to teachers who have had at least five years of

professional experience in the field that they now teach prior to becoming teachers (for example, a teacher of nursing, who prior to teaching, was a nurse for at least five years).

A) The null hypothesis for research question four is that there will be no difference between the two groups.

B) The hypothesis H1 for research question four is that the amount of apprentice content knowledge a teacher possess is (positively) correlated to an increase in the sophistication of their epistemic beliefs ($\alpha \leq 0.05$).

Methodology

Research design. The following research methodology was used to determine whether teacher's experience is predictive of whether a teacher holds sophisticated epistemic beliefs. It did so by considering the epistemic domains first identified by Perry (1970) and adapted by Schommer (1994). Using a version Schommer's (1994) Likert questionnaire on epistemic beliefs (adapted by Lee, J., Zhang, Z., Song, H., & Huang, X., (2013), the current study compares the epistemic beliefs of novice, intermediate, and expert college teachers.

Instruments. The instrument used to capture the respondent's answers was an online survey platform called *Survey Monkey*. The questionnaire that was sent out consisted of two parts:

The first part was designed to ascertain the demographics of the respondent; and, how much experience they had of each type (YTE, CK, PCK, and ACK).

The second part asked the respondents to fill out an adaptation of Lee, J., et al (2013) version of Schommer's 1994 Likert questionnaire. The belief statements of the

Likert survey were designed to identify the strength of a respondent's beliefs in seven different epistemic and pedagogical beliefs and actions. This questionnaire contained 53 belief-statements of which respondents rated on a scale of one-to one hundred ranking how strongly they believed each statement (Note: Survey draft in Appendix D uses a 1-5 scaling, however, the scale used by the *Survey Monkey* platform provided a centennial one). The 53 belief statements were clustered into seven different epistemic and pedagogic domains: the belief that knowledge is fixed or innate. The belief that learning takes effort/ is a process. The belief that knowledge comes from people in authority/ experts. The belief that the best learning model is the IT/TF approach. The belief that the best learning model is the Constructivist approach. The willingness to use pedagogical actions such as focused instruction and flexible grouping practices.

Data collection process. The survey was distributed using the *Survey Monkey* platform. In the fall of 2017, on three separate occasions between August 15 and Sept 30 2017, approximately 200 teachers from Heritage College were sent an email detailing the purpose and explanation of the study, as well as a link to the questionnaire that had been uploaded to *Survey Monkey*. The link was available for 45 days after which it was closed so that it could no longer be filled out.

Procedures: Data analysis process. The following is a step-by-step explanation of the data analysis process explaining how the respondents were identified as being a novice, intermediate, or expert in each of the four types of experiences, how the respondents were coded using the Likert survey. An inversion of data that needed to occur (Table 3.1), and finally explaining how the data was analyzed.

Step 1- Using pre-determined operational definitions of what constituted a novice, intermediate, and expert for each of the four types of teacher experiences, the sample of respondents were identified and coded accordingly (Tables 3.2 and 3.3 in Participants as seen below).

Step 2- The deconstruction the second part of the questionnaire survey, using Schommer's (1990) Epistemic Beliefs survey adapted by Lee, J., et al, (2013) was a multi-step approach. Lee, J., et al, (2013) had used a combination of the epistemological belief statements taken from Schommer (1990) and added other statements based on pedagogical beliefs and actions in order to explore the relationship between epistemological and pedagogical beliefs (p.121). The current study eliminated all belief statements that were designed to analyze the epistemic beliefs of students, and instead focused on those belief statements that were applicable to the target audience of CEGEP professors.

A total of 53 different epistemic and pedagogical belief statements were selected from the Lee, J., et al, (2013) study in order to determine the level of belief sophistication held by the respondents. Participants were asked to rank the strength of their belief of the statement in a Likert style question formatting. The 53 belief statements were divided seven clusters which represented the epistemic belief domains as identified by Perry (1968, 1970) and Schommer (1990), as well as pedagogical ones noted by Lee, J., et al. in 2013, (Table 5.1). For the purpose of the present study, in order to determine the level of sophistication of the respondent's answers for each of the seven epistemic domains, the numeric average of each of the seven belief-statement clusters was found.

Step 3- Coding the respondent's answers. The inversion: Of the seven epistemic / pedagogical beliefs, there were four where a high numeric score indicated a naive belief. In order to code all seven epistemic belief domains the same way, an inversion for these scores had to be made available. As such, the Likert scale of 1-100 was divided into three sections of 33.3% and were labelled: Low/ Naive (0-33.3%), Mid (33.4-66.6%), and High/ Sophisticated (66.7-100%). For the sake of cohesion in the coding, when the distribution tables for each epistemic domain were created, the rankings of epistemic beliefs #1, #3, #4, and #6 were inverted so that those answers could be interpreted the same as the other tables (i.e. a low numeric average entailed naïve belief sophistication, etc.). The inversion can be seen in Table 3.1 and Table 5.1 and is marked with a double asterisk (**).

Step 4- Finally, using $\alpha \leq 0.05$ as the threshold to identify a significant association, a chi-square frequency distribution algorithm was used to compare the answers of novice, intermediate, and experts of the four types teacher experiences (YTE, CK, PCK, & ACK) and the seven distinct epistemic belief domains. As there were four teacher experiences and seven belief domains, a total of 28 comparisons were made. A second round of data analysis was then conducted isolating and comparing the novice and experts. Thus, a total of 56 comparisons were calculated. Distribution tables, expected and observed frequency tables, and accepting/ rejection of the null hypothesis can all be found in Appendix F.

TABLE 3. 1

Epistemological & Pedagogical Beliefs Interpreted as Naïve/ Sophisticated

Perry/ Schommer/ Lee's epistemic/ pedagogical theories as related to teaching	Epistemic and Pedagogical beliefs	Implications of a high score
Ability to learn	Knowledge is Innate/ Fixed at birth	Naïve belief**
Speed of learning	Learning is a Process/ takes effort	Sophisticated belief
Source of Knowledge	Knowledge comes from Authority/Experts	Naïve belief**
Pedagogical Belief	Info-Tran IT/TF	Naïve belief**
Pedagogical Belief	Constructivism	Sophisticated
Pedagogical Action	Epistemic Belief #6 Focused Instruction	Naïve belief**
Pedagogical Action	Epistemic Belief #7- Flexible Grouping Practice	Sophisticated

Population and Sample

Participants. The target of this group was approximately 200 CEGEP Professors from Heritage College. From this, approximately 17.5% of the population, a sample of thirty-five teachers, chose to respond to the online questionnaire that had been emailed to them.

Characteristics of the sample. There were 24 female and 11 male respondents. As a CEGEP, the programs of the College are divided into two main streams, 16 respondents taught in the two-year Pre-University stream, and 19 were teachers from the three-year Career stream. Table 3.2 shows how teacher demographic was broken-down

into the two main academic streams of Heritage College: the two year pre-university or three year career stream, as well how the sample broke down by department.

As it is unnecessary for those who teach in the three-year career programs to hold a master's degree or higher when applicable work-related experience will suffice, the sample of teachers who chose to fill-out the questionnaire demonstrated not only a variation in amount of teaching experience (YTE) and pedagogical content knowledge (PCK), but also in content knowledge (CK), as well as professional, apprentice content knowledge (ACK). From the sample of the 35 teacher-respondents, the novices and experts of each of the four operational definitions of teacher-expert.

TABLE 3. 2

Teacher Demographics: Two-Year vs. Three- Year Stream & by Department

Two-Year Pre-University (N= 16)	**Three-year program Career (N= 19)**
Liberal Arts (N= 12)	Nursing & Early Child Care (N= 4)
Social Science (N= 4)	Agriculture & Farming (N= 1)
	Visual Arts/ New Media (N=4)
	Information- Technology & Computer Science (N= 4)
	Math, Business Admin, Accounting, & Management Technology (N= 6)

TABLE 3. 3

Teacher Demographics: Identified Novice/Experts of Each Type of Experience

Level of Teacher Expertise	Operational Definition of Novice	Operational Definition of Expert
Years of Teaching Experience (YTE)	≤ 6 years of teaching experience (N= 8)	≥ 13 years or more of teaching experience (N= 9)
Level of content knowledge specific to courses taught (CK)	≤ BA degree relevant to the field taught (Possibly holding a 2nd BA). (N= 9)	≥ a PhD (N= 10)
Level of pedagogical content knowledge (PCK)	≤ Mandatory PD sessions (N= 13)	≥ MTP diploma or equivalent (N= 14)
Amount of Apprentice/ professional content knowledge (ACK)	No applicable field work experience/ minimal field work experience such as a short term internship or co-op (N= 9)	≥ 5 years of full-time professional work experience applicable to content knowledge taught in the classroom (N= 15)

Note: There were 35 respondents in total

Ethical Considerations

The research project was originally approved by Heritage College's Research Ethics Board in the spring of 2017, and then, due to changes in how the questionnaire was to be distributed (from paper to online), an amended approval was October 3rd, 2017 (Appendix B). This research was also approved by PERFORMA and my supervisor Helen Mathieu on June 29, 2017 (Appendix C). Potential subjects were informed of the reason and purpose of the study prior to filling out the survey; an email was sent to all teachers at Heritage College. Each time the email opened with an explanation of the goal

and purpose of the study and an e-link to the questionnaire using the *Survey Monkey* platform. If they chose to open the link, the goal and purpose of the study were re-iterated on the first page. Respondents were free to choose to participate or not. See Appendix E). In order to control for a participant's bias, the full intent of the survey (to compare novice and experts of different categories of teacher experiences) was withheld from the respondents. Instead, they were given a more vague explanation: that the purpose of the study was to examine "various" teacher's demographics and possible associations with preference of different types of teaching methods.

The use of *Survey Monkey* made it easy to ensure the privacy of the respondent's answers. As the questionnaire was anonymous and distributed through a third-party online platform, there were not ethical issues of privacy or confidentiality. As a professor of Heritage College, I was given access to the college's *Survey Monkey* account. The results of my data will remain in this account for 5 years, then the link will be discarded.

This study has the approval of Heritage College's Dean, Roya Abouzia, who is also the chair of the Heritage College's Research Ethics Board. A copy of my application and the consent form are located in Appendix B.

CHAPTER FOUR

Presentation of the Collected Data

The goal of this study is to compare the epistemic and pedagogical beliefs of CEGEP teachers. Data collected from the respondents, 35 college professors, was analyzed in multiple stages. First the respondents were ranked based on their level of expertise (novice, intermediate, expert) in four types of teacher experience. These were: The number of years a person had been a classroom teacher; content knowledge expertise (level of education applicable to the field they teach); pedagogical content knowledge expertise (level of education in a program such as the Universite de Sherbrook's MTP certificate); and apprentice content knowledge expertise (level of previous but applicable to teaching work experience) as seen in Table 3.3.

Determining whether there exists a correlation between various types of teacher expertise and the sophistication of epistemic beliefs was done by comparing the epistemic beliefs of the novice and experts found within each of the four types of teacher experience. The rest of the survey that the respondents completed was based on the ideas of Perry (1970), and Schommer (1990), and adapted by Lee (2013). It was a Likert survey of 53 epistemic belief statements which were divided into seven epistemic and pedagogical domains: the ability to learn, the structure of knowledge, and the source of knowledge. It also probed into the respondent's pedagogical beliefs by determining which teaching paradigm they preferred (IT/TF vs Constructivism), and, their willingness to perform pedagogical actions such as classroom management and student-focused activities.

The sophistication of a respondent's epistemic beliefs was determined by calculating the mean of each of the seven epistemic beliefs that made up the 53 statement questionnaire. Keeping in mind the inversion of epistemic belief #1, #3, #4, and #6, the respondent was operationally defined as holding either low (naïve), mid, or highly sophisticated beliefs for each of the seven epistemic and pedagogical belief domains.

In the first round of analysis, the answers of all 35 responses were compared, resulting in 28 comparisons (4 experience types x 7 epistemic/ pedagogical beliefs). For the second round of data analysis, the novice and experts of each of the four teacher experiences were first isolated, and compared to the seven epistemic beliefs (another 28 comparisons). Thus, a total of 56 chi-square frequency algorithms were calculated. For an association to be deemed statistical significance, the p- value needed to be $\alpha \leq 0.05$. Distribution tables, expected and observed frequency tables, and the rejection or acceptance of the null hypothesis can all be found in Appendix F. Of the 56 comparisons, seven demonstrated an association that had a statistical significance (Table 4.1).

TABLE 4. 1

Demonstrated Statistical Significance where $\alpha \leq 0.05$

Types of Teacher Experiences	**Correlation- statistical significance found**	
YTE	-------	
CK	Epistemic belief #3 Novice/ Expert	**0.032**
	Epistemic belief #7 All Respondents	**0.028**
	Epistemic belief #7 Novice/ Expert	**0.008**
PCK	Epistemic belief #2 All Respondents	**0.035**
	Epistemic belief #2 Novice & Expert	**0.009**
	Epistemic belief #4 Novice & Expert	**0.028**
ACK	Epistemic belief #7 All Respondents	**0.037**

CHAPTER FIVE

Analysis and Interpretation of the Data and Results

The following section explores the findings of each type of teacher experience and whether expertise indicated a sophistication of the seven epistemic and pedagogical beliefs. A summary may be found below in table 5.1. As discussed in the methodology section (and Table 3.1), it is important to note that in order for all epistemic beliefs to work with the analyzing algorithm that was used to determine whether an individual held naive or sophisticated epistemic beliefs, beliefs #1, #3, #4, and #6 needed to be "inverted" meaning that a high numeric average meant a naïve belief rather than a sophisticated one. This inversion is denoted with a double-asterisk (**) in Tables 3.1 and 5.1.

TABLE 5. 1

Epistemic beliefs, belief statements, and results

Type of epistemic belief	**Belief statements from Lee, J. et al survey (2013) (adopted from Schommer 1990)**	**Results Of Association**.
Knowledge is Innate/ Fixed at birth	There is not much you can do to make yourself smarter as your ability is fixed at birth; one's innate ability limits what one can do; some children are born incapable of learning well in certain subjects; students who begin school with "average" ability remain "average" throughout school; the really smart students do not have to work hard to do well in school. **	n/a
Learning takes Effort/ Is a Process	How much you get from learning depends mostly on your effort; getting ahead takes a lot of work; that if one tries hard enough, then one will understand the course material.	**PCK** *negative* All Respondents α 0.035 Novice & Expert α 0.009
Knowledge comes from Authority Experts	If scientists try hard enough, they can find the truth to almost anything; Anyone can figure out difficult concepts if one works hard enough; I believe there should exist a teaching method applicable to all learning situations; Scientific knowledge is certain and does not change. **	**CK** *positive* Novice/ Expert α 0.032

Info-Tran IT/TF as a learning paradigm	The traditional/lecture method for teaching is best because it covers more information/knowledge; It is best if teachers exercise as much authority as possible in the classroom; Good teaching occurs when there is mostly teacher talk in the classroom; Learning mainly involves absorbing as much information as possible; Students have to be called on all the time to keep them under control; Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it; A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves; No learning can take place unless students are controlled; Teachers should have control over what students do all the time; Learning to teach simply means practicing the ideas from lectures without questioning them; I have really learned something when I can remember it later; Teaching is simply telling, presenting or explaining subject matter; The major role of a teacher is to transmit knowledge to students; Learning occurs primarily from drilling and practice. **	**PCK** *positive* Novice/ Expert α 0.028
Constructivism	It is important that a teacher understand the feelings of the students; Good teachers always encourage students to think for answers themselves; Learning means students have ample opportunities to explore, discuss and express their ideas; In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact; Every child is unique or special and deserves an education tailored to his or her particular needs; Effective teaching encourages more discussion and hands on activities for students; The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication; Instruction should be flexible enough to accommodate individual differences among students; Different objectives and expectations in learning should be applied to different students; Students should be given many opportunities to express themselves; The ideas of students are important and should be carefully considered; Good teachers always make their students feel important; Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving; In order to learn complex material, students need information presented to them in several different ways; If students can't apply what they learn to the real world, they don't really understand it; It is important that students study real life problems that they are likely to encounter outside of the classroom; I regularly incorporate student interest into lessons; Students should help establish criteria on which their work will be assessed.	n/a
Focused Instruction	I am able to monitor the progress of all my students to my satisfaction; I maintain a rapid pace of instruction in my classes; in my class, disruptions of instructional time are minimized. **	n/a
Flexible Grouping Practice	I frequently group students according to different levels of academic ability; student groupings in my class depend on student need; and, student groupings in my class depend on my instructional purposes.	**CK** *negative* All Respondents α 0.028 Novice/ Expert α 0.008 **ACK** *positive* All Respondents α 0.037

Analysis of Distribution Tables

Type of teaching experience: Years in the classroom (YTE). As can be seen in Table 3.3, novice teachers were defined as those teachers who had six years or less of teaching experience (N= 8) and expert teachers were those who had more than 13 years of teaching experience (N= 9).

This study found that overall, years of teaching experience is **not** statistically associated with any of the epistemic beliefs. No combination of YTE and any of the seven epistemic beliefs had $\alpha \leq 0.05$.

Type of teaching experience: Content knowledge. Novice teachers (N= 9) were defined as those teachers who held no more than a bachelor's degree in the field that they taught (perhaps holding two BA). Expert teachers (N= 10) were defined as those teachers who held a PhD in the field that they taught. (Table 3.3)

Content Knowledge expertise was found to be **positively correlated** with holding sophisticated epistemic belief #3- **knowledge comes from authority/ experts.** This statistical association was strong when novice and experts were isolated (**0.032**). This association demonstrates that the more educated a person is in their field, the more sophisticated their epistemological beliefs are on the question of where knowledge comes from, and, that authority can be questioned or criticized.

Interestingly however, content knowledge expertise was **negatively associated** with the **use of flexible grouping practices** (Epistemic belief #7). When all 35 respondents were compared, the p-value was **0.028.** The association became stronger when the responses of the content knowledge novices and experts were isolated (**0.008**). The negative association of content knowledge expertise and the use of flexible grouping

practices, found in Table F14.4, demonstrates that the more CK expertise a person holds, the less willing they are to use teaching strategies such as use of flexible student grouping practices.

Type of teaching experience: pedagogical content knowledge (PCK*).* Novice teachers were defined as those teachers whose only pedagogical content knowledge was limited to what they might have learned during mandatory PD sessions (N= 13). Expert teachers were those who held a MTP diploma or equivalent (N= 14). (Table 3.3)

A review of the teacher distribution Table F16.1 indicates that pedagogical content knowledge experts hold naïve epistemic beliefs regarding learning and whether it takes effort/ is a process. By contrast, PCK novices are far more likely to see knowledge acquisition as a process that requires effort (Lee, J., et al, 2013), and that learning happens gradually over time (Maravilla & Gomez, 2015). This **negative association** between PCK expertise and epistemic beliefs about learning and effort became stronger when the novice and experts of the group were isolated (All respondents **0.035**/ Novice and experts **0.009**). Belief statements for this domain were: How much you get from learning depends mostly on your effort; getting ahead takes a lot of work; and, that if one tries hard enough, then one will understand the course material. It is unclear why those teachers who have spent years studying pedagogy, learning, and knowledge would rate their belief of these statements so low.

At the same time, PCK expertise was found to be **positively correlated** with **the rejection of the IT/TF learning paradigm** (epistemic belief #4). When novice and experts were isolated, the p-value was **0.028**. It would appear that those teachers who

have studied current pedagogical theories understand that the basic tenants of IT/FT are outdated and disagreeable (Table F18.1 and Table F18.4).

Type of teaching experience: apprentice content knowledge. As can be seen in Table 3.3, novice ACK teachers were defined as those respondents with no applicable field work experience, or, have had minimal field work experience such as a short term internship or co-op (N= 9). Expert ACK teachers were defined as those respondents who had at least five years or more of professional work experience applicable to content knowledge (N= 15).

As opposed to content knowledge experts who have a negative relation with the willingness to use pedagogical techniques such as flexible student grouping practices, distribution Table F28.1 demonstrates a **positive correlation** between ACK experts, that is people who have at least five years of profession work experience prior to becoming teachers, and the willingness to use flexible grouping practices (AR **0.037**). Teachers who have had full time, professional work-experience, are more willing to adopt student-focused learning environments.

Interpretation of the Results

Evidence supports Schommer's (1990) theory of independent epistemic beliefs. The major difference of epistemological theories between Perry (1970) and Schommer (1990) is that whereas Perry argued that development of the epistemic beliefs occurs for all beliefs as a cohesive whole, as one develops, so too do the others. By contrast, Schommer's (1990) main distinction was to argue that the epistemic domains are independent of one another, such that one may have high belief sophistication in some domains, and low belief sophistication in others. The evidence found in the current

study provides support for Schommer's argument that epistemic beliefs are independent of one another. Indeed, it seems that one may hold both naïve and sophisticated epistemic beliefs simultaneously.

Raising the minimal requirement of α from ≤ 0.05 to ≤ 0.1. Had the original hypothesis of this study set the minimal requisite of statistical significance at $\alpha \leq 0.1$ instead of $\alpha \leq 0.05$, the total number of associations with statistical significance jumps from seven to fifteen (Table 5.2). Though these associations are not as statistically significant as the ones that has results that were ≤ 0.05, the details of the ≤ 0.1 comparisons help paint a better epistemic and pedagogical picture of what occurs in our classrooms. As such the following section links these overall findings to previous research and discusses themes that emerged.

TABLE 5. 2

If the hypothesis had been set α ≤ 0.1. All Respondents (AR) and Novice vs Experts (N

Experience Type	***Belief Type***	***α value***	***Association Type***
YTE	Epistemic Belief #5- Constructivism as a learning paradigm	0.097 (AR)	Positive *
YTE	Epistemic Belief #6	0.069 (AR)	Positive
	Focused Instruction	0.079 (N/E)	Positive
CK	Epistemic Belief #3	0.064 (AR)	Positive
	Knowledge comes from Authority/ Experts	0.032 (N/E)	Positive
CK	Epistemic Belief #4 Info-Tran IT/TF as a learning paradigm	0.076 (N/E)	Negative
CK	Epistemic Belief #5	0.099 (AR)	Negative
	Constructivism as a learning paradigm	0.076 (N/E)	Negative
CK	Epistemic Belief #7	0.028 (AR)	Negative
	Flexible Grouping Practice	0.008 (N/E)	Negative
PCK	Epistemic Belief #2	0.035 (AR)	Negative
	Learning takes Effort/ Is a Process	0.009 (N/E)	Negative
PCK	Epistemic Belief #4	0.072 (AR)	Positive
	Info-Tran IT/TF as a learning paradigm	0.028 (N/E)	
ACK	Epistemic Belief #2 Learning takes Effort/ Is a Process	0.056 (N/E)	Positive
ACK	Epistemic Belief #7 Flexible Grouping Practice	0.037 (AR)	Positive

Years of teaching experience. When $\alpha \leq 0.1$, years of teaching experience demonstrated two associations that had statistical significance. Distribution Table F5.1 displays that when teachers have either very little classroom teaching experience (≤ 6 years of teaching), or, a lot of classroom teaching experience (≥ 13 years of classroom teaching), they tend to hold sophisticated epistemic beliefs regarding the constructivism as a learning paradigm. By contrast, the belief sophistication of intermediate teachers decreases (seven-12 years of classroom teaching experience). Perhaps this u-curve may be evidence that supports Berliner's (2001) claims that the development of expertise is not linear.

Furthermore, when $\alpha \leq 0.1$, YTE experts were also found to have moderately sophisticated beliefs regarding the use of focused instruction (Table F6.1**, AR 0.069** and **N/E 0.079**). According to Wahlstrom and Louis (2008), focused instruction emphasizes the teachers' responsibility for managing time in the classroom, as well as their commitment to maintaining student engagement with very specific learning activities. Combined, these two results show that there is a slight uptick of epistemic belief sophistication and years of teaching experience. It would seem that as one gains confidence in their classroom management skills, they also become more confident in adopting constructivist teaching approaches.

Content knowledge expertise. A dismal picture of epistemic belief sophistication and content knowledge becomes more apparent when α is ≤ 0.1. While content knowledge experts hold very sophisticated beliefs about the source of knowledge and the legitimacy of challenging authority (Table F10.1), this set sophisticated beliefs does not seem to extend to what happens inside the classroom. The significant negative relation

found in the comparison of content knowledge expertise and willingness to use of flexible student grouping practices (Table F14.4, **AR 0.028** and **N/E 0.008**), can be further flushed out when it is observed that teachers who hold content knowledge expertise are more likely to endorse the IT/TF teaching model (**0.076**), and at the same time, to also hold naive beliefs about the constructivist model (**0.076**).

Collectively, these findings suggest a web of naive epistemic beliefs. The failure to use pedagogical techniques such as flexible grouping practices seems to stem from core naïve epistemic beliefs, where one remains steadfastly loyal to the traditional teaching models, while at the same time, holding a naïve/ simple understanding of the principles of constructivism. As such, it is unsurprising that the use of flexible grouping practices scored low, as these findings suggest that content experts tend to hold borderline naïve epistemic beliefs in general.

According to Wahlstrom and Louis (2008), standard contemporary practices reflect the learner-centered teaching practice and the kind of instruction that emphasizes student learning. Flexible grouping practices reflect the kind of instructional practices which are more responsive to students at different levels and emphasize a cooperative rather than an individualized learning environment. The problem is that this type of pedagogical thinking is opposite of the traditionally-minded CK expert and the over-used IT/TF teaching mindset of higher education. It appears that the longer one stays in school (perhaps thereby failing to accrue lessons learned outside of the classroom), the more likely one is to continue to use traditional teaching models, and at the same time, the less likely to endorse principles of constructivism. The main take away of the current

research is that while intuition may dictate that good students would make for good teachers, this set of data tells a different story.

Pedagogical content knowledge expertise. It is obvious that graduates of pedagogical and educational programs have been indoctrinated to argue against the information-transfer / teacher-focused approach to learning **(AR 0.072 & N/E 0.028).** However, the question is begging to be asked, what is going on with PCK experts and their naïve beliefs about learning and effort (Schommer's Ability and Speed of learning) (**AR 0.035** and **N/E 0.009**)?

One possibility is that Perry (1968) and Schommer's (1990) theory on epistemic beliefs are themselves too simplistic and need to be updated to find themselves within the new learning paradigm of constructivism. After all, Schommer's belief statements were written in 1990, perhaps the subsequent 30 years of pedagogical dialogue that has ensued has changed how these belief statements ought to be interpreted (i.e. perhaps scoring low no longer means a naive belief). Recent research has indicated that Schommer's questionnaire may not be all that reliable, and its use is based mostly on ease of administering to many people at the same time (Clarebout, Elen, Luten, & Bamps (2001); DeBacker, Crowson, Beesly, Thoma, & Hestvold, 2010). Perhaps pedagogical content experts understand the complexities of learning, and recognize that effort alone is insufficient.

Applicable content knowledge expertise. Admittedly, applied content knowledge expertise was a post-hoc wild card, nevertheless, this study found ACK expertise does actually have its advantages in the classroom. In a major contrast with content

knowledge experts, ACK expertise is positively associated with holding sophisticated pedagogical beliefs regarding the use of flexible student grouping practices **(0.037).** Further, when $\alpha \leq 0.1$, in contrast of PCK experts, having ACK expertise is positively associated with holding sophisticated beliefs about the process of learning **(0.056).**

The willingness to try pedagogical techniques such as flexible grouping practices, combined with the moderately sophisticated belief that that learning takes effort, indicates that perhaps instead of seeing as education as unidirectional, where one learns and then leaves school, perhaps more emphasis should be placed on noting how the world-outside-the-classroom can help the traditional classroom modernize both pedagogical and epistemological philosophies.

Additional Comments

Lurking variables. During data analysis, this study pondered whether any lurking variables existed within the data. As such, gender of the teacher and discipline taught were also considered. While no statistical significance was found when gender was compared, as one may see in Table 5.3 below, teachers in Math, Business Admin, Accounting, Management Technology, and to a lesser degree Liberal Arts all held naive epistemic/ pedagogical beliefs regarding the constructivist teaching paradigm as compared to teachers from other disciplines (**p-value 0.032**).

Table 5. 3

Observed Frequency of Teacher's Discipline & Epistemic belief #5- Constructivist Paradigm

Discipline	**LOW**	**MID**	**High**	**Total**
Liberal Arts	0	3	9	**12**
Social Science	0	0	4	**4**
Visual Arts, New Media	0	1	3	**4**
Info-Tech & Computer Science	0	0	4	**4**
Nursing, ECCE	0	0	6	**6**
Agriculture	0	1	0	**1**
Math, Business Admin, Accounting, & Management Technology	0	3	1	**4**
Total	**0**	**8**	**27**	**35**

CHAPTER SIX

Conclusions and Final Thoughts

Conclusions

This study compared the epistemic beliefs of novice and expert CEGEP teachers. By comparing four types of teacher expertise: years of teaching experience, content knowledge, pedagogical content knowledge, and professional/ apprentice content knowledge; to the seven epistemic and pedagogic beliefs of Perry (1968, 1970), Schommer (1990, 1994), and Lee, et al (2013). This study considered 56 possible associations (28 all respondents/ 28 novice and expert only). Of these comparisons, seven were found to have a statistical significance such that $\alpha \leq 0.05$.

Considered as a whole, these findings show that the amount of classroom experience a teacher accrues does not impact the sophistication of their epistemic beliefs, meaning that simply performing the same types of teaching techniques year after year does not make a person an expert teacher. If α had be set at ≤ 0.1, then data would have shown that teachers who have more than 13 years of classroom experience hold moderately sophisticated ideas of classroom management as seen in their score on epistemic belief #6, focused instruction (0.069).

Additionally, the study found that content knowledge experts hold sophisticated ideas about the source knowledge, the role of experts, and the legitimacy of questioning authority (α 0.032). Yet at the same time, this study also noted that when $\alpha \leq 0.1$, that teachers with high levels of education in their field (PhDs) are slow to give up the IT/TF model (α 0.076), and, hold naïve beliefs in regard to modern constructivist teaching

approaches (α 0.076). As such, content knowledge experts are unwilling to use experimental pedagogical techniques such as the use of flexible grouping practices (epistemic belief #7, α 0.008).

Teachers who were experts of PCK held sophisticated epistemic beliefs regarding the rejection of the IT/TF teaching model (AR 0.072, N/E 0.028). This result is unsurprising, modern pedagogical philosophy consistently denounces the sage on the stage teaching model, and it would seem that recent graduates of pedagogy in higher education endorse these ideas. However, these same PCK experts were found to hold very naive epistemic beliefs that learning takes effort (epistemic belief #2, AR 0.035, N/E 0.009). The results of this association are puzzling. Why did pedagogical content knowledge experts score so low in this section? Considering the results of CK experts, I thought perhaps this puzzling PCK finding could be explained by an overlap of teachers who were both content knowledge and PCK experts. However upon inspection, only two respondents were experts of both CK and PCK (ID #6 and #11).

It seems to leave one of two conclusions, either Schommer's epistemic beliefs regarding learning and effort need to be updated to match modern pedagogical theory, or, in an ironic twist, somewhere along the way of becoming PCK experts, individuals become very confused as to how people learn. The fact the respondents of this study came from a diverse range of educational institutions demonstrates that this might be a core philosophical confusion among PCK experts rather than as a simple one-off misperception.

Finally, unlike PCK experts, when $\alpha \leq 0.1$, it was noted that ACK experts typically hold fairly sophisticated epistemic beliefs regarding the idea that learning is a

process or that it takes effort (0.056). Moreover, in contrast to CK experts, ACK experts were found to perceive teaching instruction techniques such as flexible grouping practices positively (α 0.037). Perhaps it is because their real world experience demonstrated to them the importance of being able work together and collaborate.

Indeed, Evers, Rush, and Berdrow (1998) advocated that we need to be "fostering a [future] employee's ability to think creatively, communicate effectively, work collaboratively, solve complex problems, understand issues from multiple and global perspectives, manage themselves along with tasks and others, and provide leadership of innovation and change" (p. 247). Real world hands-on apprentice work experience provides opportunity to confirm one's self-efficacy and to show others how to do the same.

Limitations of the Study

There were multiple limitations of this study. The primary limitation was that there were only 35 teachers who chose to take part in this study. Not only does this make up only 17.5% of the target population, this low sample number also made finding relations using a chi-square frequency distribution algorithm tricky. Originally there had been five levels of teacher expertise (novice, amateur, intermediate, expert, master expert) as well as five levels of belief sophistication (Low, Mid Low, Mid, Mid High, and High), but due to the low number or respondents, some of these categories were amalgamated.

The process of amalgamating the definitions perhaps led to some statistical confusion. This might for example, account for the reason why when a statistical significance was set at $\alpha \leq 0.05$, YTE was not found to be significantly associated with

any of the epistemic and pedagogical beliefs. In the amalgamation of data, whereas originally YTE novices were those who had no more than three years of classroom experience and YTE experts were those who had 20+ years of teaching experience. By the time the chi-square calculations were underway, the definition of an YTE novice had been opened to include anyone who had equal to or less than six years of experience, and the operational definition of an YTE expert had been reduced to from 20 + years to someone who had 13+ years of teaching experience. Perhaps the operational definition of YTE became too broad to provide meaningful data.

This leads to a second limitation of the study, that the operational definitions were quite arbitrary. Determining how to define teacher expertise was difficult, and perhaps different definitions would lead to different results.

Finally, this survey was emailed three times to all teachers at the start of the semester. It was believed that during the weeks leading up the beginning of the semester and in the first few weeks of school teachers would be most reflective of their epistemic ideas, and at the same time, be less likely to be suffering teacher burnout which occurs later in the semester. The results of this study may have been entirely different had teachers filled out the questionnaire at a different time in the semester, or over the course of a year. In fact, it would be interesting to compare the same teachers' answers to see whether their answers remained the same at the end of the semester.

Suggestions for Further Research

Considering the data found in the current study, the main focus of future research ought to be the inter-relation between epistemic beliefs and content knowledge, as it would seem that possessing a high level of content knowledge is negatively correlated

with sophisticated epistemic beliefs. This study found that content knowledge experts are more likely to continue to use of the IT/TF model (#4), and, that they are resistant to the basic principles of constructivism (#5).

These core epistemological beliefs shape the content knowledge expert's pedagogical beliefs thereby limiting the types of pedagogical actions they are willing to do, as seen with the inflexibility of student grouping practices (#7); perhaps because they're too busy being the 'sage on the stage' and lecturing to be concerned about where, how, and with whom students sit. In retrospect, this finding ought not to be surprising. As previously noted, Knapper (2010) argued that the prevalence of the traditional information-transmission approach is due to the fact that most faculty model their teaching style upon the uncritical adoption of their own academic experience. Consequently, it would seem as though content knowledge experts are stuck in a loop of epistemological and pedagogical naivety that dates back to medieval times.

Another association whose results were disquieting was between pedagogical content knowledge and the epistemic idea that learning takes effort and is a process. It is unclear as to why pedagogical content knowledge was found to have such a strong negative correlation in this regard. At the same time, PCK expertise was found to be strongly denounce the IT/TF teaching model. Perhaps the problem is that although PCK experts recognize the language of the pedagogical theory they've studied, they have not had enough applicable experience to recognize it in action. Or, perhaps the problem was with Schommer's belief statements, and those who have spent time studying pedagogy in higher education understand that the complexities of learning cannot be boiled down to student effort.

This leads to our last highlight and suggestion for further research, the importance and benefit of apprentice experience (ACK) that a teacher brings into the classroom. As seen with content knowledge expertise (especially when $\alpha \leq 0.1$), spending years in the lecture hall as a student does not necessarily make you a better teacher, in fact it seems as though it can hinder the teaching process as the extra years of education continue to engrain the old IT/TF model. Rather, what seems to make for an adventurous teacher is real world, practical, professional work expertise that may be parlayed into lessons taught in the classroom. If this can be found in further research, it could mean that we analyse the profiles of prospective teachers in a different light.

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Appendix A

Ethical Issues

This brief written proposal ethics to the Ethics board of Approval was subsequent of two one hour long meetings with the Dean of the college, Heritage College.

University of Sherbrooke performa MTP master's thesis proposal.

Submitted by Stacie Sivyer, August 3, 2017

Topic: The Epistemic Beliefs of Novice and Expert College Teachers

Purpose: Two-fold

Purpose 1- To explore the differences in how novice and expert teachers think about knowledge- how it is constructed, transferred, and acquired.

Purpose 2- To explore different indicators of expertise in teaching.

Research Method Design:

A voluntary and anonymous survey. Distribute to all teachers at Heritage College. Distribution will occur by using *Survey Monkey*.

Timeline:

All teachers will receive an email a few days prior to the Welcome Back, this email will tell teachers the nature and purpose of the survey, and ask them to look for it in their mailboxes, which will be available any time after the Welcome Back session. Teachers will also be notified of the deadline to return surveys, which will be Friday Sept 22, 2017. Initial Email to teachers was sent Monday August 14, 2017; Deadline to return surveys: Friday Sept 30, 2017

Appendix B

Approval of Research from Heritage College

CÉGEP Heritage COLLEGE www.cegep-heritage.qc.ca

Gatineau, June 14, 2017 AD 193 17

RE: Thesis research and permission to conduct a survey

Dear Stacie,

Thank you for continuing to improve your education into pedagogy and college teaching through the Master Teacher Program of Performa. Our students and College as a whole benefit from your engagement.

We understand that you require a survey of your teaching colleagues here at Cégep Heritage College this fall. We understand that your thesis *The Epistemic Beliefs of Novice and Expert College Teachers* will explore the differences between how novice and expert teachers think about knowledge (how it is constructed, transferred, and acquired) and will explore the different indicators of expertise in teaching.

We understand that you will be administering a voluntary and anonymous survey for our faculty. It will be in paper form distributed through their faculty mailboxes by mid-August with a deadline of late September 2017.

The College grants you permission to conduct this survey as we discussed. Should you require the assistance of Academic Services, please let us know and we will assist you as best as we can.

We look forward to your findings, and hope you find a venue here at the College to do so.

Sincerely,

CÉGEP Heritage COLLEGE

www.cegep-heritage.qc.ca

Gatineau, October 3 2017 AD 032 18

RE: Thesis research and permission to conduct a survey

Dear Stacie,

As per your request, this is an amended letter due to a change mandated by the research ethics board, where you are completing your work.

Thank you for continuing to improve your education into pedagogy and college teaching through the Master Teacher Program of Performa. Our students and College as a whole benefit from your engagement.

We understand that you require a survey of your teaching colleagues here at Cégep Heritage College this fall. We understand that your thesis *The Epistemic Beliefs of Novice and Expert College Teachers* will explore the differences between how novice and expert teachers think about knowledge (how it is constructed, transferred, and acquired) and will explore the different indicators of expertise in teaching.

We understand that you will be administering a voluntary and anonymous survey for our faculty. It will be electronically distributed through to faculty by mid-August with a deadline of late September 2017. The online survey format will be set up to respect all confidential information of the participants.

The College grants you permission to conduct this survey as we discussed. Should you require the assistance of Academic Services, please let us know and we will assist you as best as we can.

We look forward to your findings, and hope you find a venue here at the College to do so.

Sincerely,

Roya Abouzia
Academic Dean
Directrice des études

e

University de Sherbrooke Consent Form

CONSENT FORM

Participation in a study or project regarding research, innovation, or critical analysis in the context of a master's degree in college teaching[1]

In the context of my studies related to a Masters in College Teaching at Université de Sherbrooke, I am conducting a research project or innovation project or a project involving critical analysis supervised by Helene Mathieu.

1. PROJECT TITLE: EPISTEMIC BELIEFS OF TEACHERS IN HIGHER EDUCATION

2. LEAD RESEARCHER: STACIE SIVYER

Telephone:

Email:

3. INTRODUCTION

This form presents the ethical considerations of this project. It is important to read it and to understand each point. As lead researcher, I am available to answer all of your questions.

You will be asked to fill out an anonymous survey. This survey is designed to explore the epistemic beliefs (beliefs about knowledge- what it is, how it is best constructed, transferred, and acquired) of teachers in higher education. There is a three part survey which considers 1- Teacher's general and educational demographics, 2- Teacher's preferred teaching method/ model, and 3- teacher's epistemic beliefs. The third part of the survey on epistemic beliefs is a 53 Likert questionnaire based on research from Schommer (1990, 1994) and adapted by Lee, J., Zhang, Z., Song, H., & Huang, X. (2013) as seen in: Effects of epistemological and pedagogical

1 In the case of an emergent methodology, researchers must consult the CER if, while carrying out the project, any changes in the methods of data collection are likely to have ethical consequences and related risks that might have repercussions for participants.

beliefs on the instructional practices of teachers: A Chinese perspective. *Australian Journal of Teaching Education. 38* (12). 120-146.

4. PROJECT DESCRIPTION

Context of the study or project: a voluntary and anonymous survey

General research question: How do epistemic beliefs of teachers of higher education differ?

Objectives: To learn more about the epistemic belief of teachers in higher education.

Methodology: Survey teachers at Heritage College, a small English CEGEP in West Quebec. Survey will contain three parts: 1- On Teacher demographics and education, 2- On teacher's preferred teaching method, 3- On teacher's epistemic beliefs.

Period and duration of data collection: Data collection mid-Aug, Mid-Sept 2017.

5. PARTICIPATION

Who is participating in this project or study?

Teachers of Heritage College

Role of Participants (including activities to be done and the time required for these)

Participant teachers will be those who volunteer to fill out an anonymous survey.

6. ADVANTAGES OF PARTICIPATION

What are possible benefits to participants?

To further explore the epistemic teachers in higher education.

7. BENEFITS, RISKS, AND DRAWBACKS

What are the potential benefits of this research for society at large?

(Positive benefits in the field of Education, benefits for the betterment of society as a whole as a result of acquisition of knowledge)

- Potential benefits include obtaining a better understanding of teacher's epistemic beliefs in higher education.

- Increasing the number of expert teachers in higher education.

- Of professional pedagogical development in higher education.

What are the foreseeable risks involved for participants?

(A negative effect on the well-being of participants, whether at the social, behavioural, psychological, physical, or economic level. Risk is a function of the scope or seriousness of the *effect* and the probability of it occurring.)

No risks that we are aware of. Participation in the survey is voluntary. Results remain anonymous.

Is this project situated beneath the threshold of *minimal risk*?2

Yes, as there are no risks to participant.

8. PRIVACY AND CONFIDENTIALITY

How will the data be disseminated and stored?

Respondents are free to choose to participate or not. Participants are asked to sign a consent form and to return it at the same time as when they return the completed survey to be enclosed in a sealed envelope provided by the researcher.

Storage of data and results: The surveys will be kept in a safe place at my house.

For how long will the date be stored?

Post collection and analysis, the surveys will not return to the college for seven years. At which time, I will shred the surveys at the school.

2 Minimal risk exists when the probability of occurrence and the level of possible drawbacks or ris are comparable to those encountered in the daily life of the participants.

9. COMPENSATION AND EXPENDITURES

Is there any monetary or other compensation for time spent, travel, etc. for project participation?

Yes X☐ No ☐

If yes, justify, and specify the form of this compensation:

There will be two $25 gift certificates from a choice of specific stores in the area as an incentive to participate. The two gift certificates will be randomly drawn from the signed consent forms after the deadline has closed.

10. CONTACTS

If you have questions about this project, you can contact the LEAD RESEARCHER. If you have questions about the program, contact the Research Supervisor or the COORDINATOR OF THE MASTERS PROGRAM at performa@usherbrooke.ca

11. CONSENT OF THE PARTICIPANT

I have read and understood the content of this form. I have had the opportunity to ask all my questions, and these have been answered to my satisfaction. I know that I am free to participate in the project and that I remain free to withdraw at any time by verbal notice, without prejudice. I certify that I was given all the time I needed to make my decision. I have signed below, consenting to participate in this project.

Name of participant*: _____

Signature: _____

(*If a minor is involved, consent and signature of parental authority)

Date: _____

12. COMMITMENT OF THE LEAD RESEARCHER

I certify a) that I have answered the questions of the signatories in regard to the terms of this consent form, and b), that I clearly informed them of their freedom to end their participation in the project at any time.

Name of the lead researcher: _____

Signature: _____

Date: _____

Appendix C

Form for the Ethical Evaluation of Projects

UNIVERSITÉ DE SHERBROOKE

Faculty of Education

Form for the ethical evaluation of projects

1. **PROJECT COORDINATOR(S)**

Student(s): Stacie Sivyer

Telephone number:

Email:

Study program: Master Teacher Program

Pedagogical activity: MA Thesis Research

Project director: **Dianne Bateman**

Registration semester of activity: F2017

2. PROJECT DESCRIPTION

Project title: The epistemic beliefs of novice and expert teachers

Project funding:

None X Source:

Is it an inter-college project?

Yes No X

If yes, other colleges involved:

Date for beginning of data collection: August 22, 2017

Project summary

This study will compare the epistemic beliefs of novice and expert teachers. Expert teachers will be ranked on three distinct variables: Number of years of teaching experience, education in the subject that they teach (content knowledge), and accrued pedagogical content knowledge. They hypothesis is that though all three expert-identifying variables will be positively correlated with the sophistication of epistemic beliefs, the variable that will have the strongest positive correlation will be those teachers who have pedagogical content knowledge. This is important because as of now, most institutions of higher education do not mandate that their teachers have pedagogical knowledge- either when they hire novice teachers, or later in their teaching career through professional development programs/ courses. This study might provide an argument for why this is unacceptable.

3. ETHICAL ASPECTS

Balance between risks and benefits

What are the risks to participants?

There are no risks involved in this study as it is an anonymous survey, which participants will volunteer to fill-out.

Is the project located below the threshold of minimal risk?[3]

Yes.

The only risk is that participants will be given a vague description of the purpose of the survey. Respondents will be told that I am researching the epistemic beliefs of teaches in higher education, without specifically stating that I am looking at the difference between novice and expert teachers. This will be done to limit a possible bias in how respondents answer the survey questions.

If there is a possibility of risk to participants, what measures will you take to mitigate these risks?

---

3 Minimal risk is present when the probability of occurrence and the level of possible risk or drawbacks are comparable to those encountered in the daily life of participants.

There will be no risks to participants.

How much time is required for participation?

Filling out the survey: 25-40 minutes,

What are the benefits to participants?

To learn more about how epistemic beliefs shape teaching

Is there any monetary or other compensation for project participation such as for time spent or travel, etc.?

Yes No X

If yes, justify, and specify the form of compensation:

N/A

Free and informed consent

Is the research **consensual** in nature?

Yes. Surveys will be emailed to teacher's Heritage College email. The email will explain the purpose of the survey and its uses.

Will consent of participating individuals be requested? Will they be aware that they are involved in a trial project in the context of a master's degree in college teaching (MEC) and aware of the type of project?

Yes X No

What are the **measures taken to ensure the free and informed consent of all participants?**

Teachers will be emailed and informed of the nature and purpose of the survey. They will also be told that if they choose to participate in the anonymous survey, which will be attached as a link within the email. They will have until Sept 30, 2017 to fill-out and re-send survey.

How will participants for the project be recruited?

Participants will be recruited via a mass email sent to all Heritage College teachers.

When will the consent forms be distributed and signed by the participants?

At the same time as the surveys.

Who will be handing out and collecting the consent forms?

Consent will be given prior to opening the online survey link.

Does the project involve **minors and/or legally incompetent individuals?**

Yes No X

If yes, specify the precautions taken in this regard: Parental consent is required by law for the participation of minors.

Confidentiality of data

What measures will be taken to ensure **the confidential nature and anonymity of data?**

As the sole researcher, I will be the only person who has access to the data. Surveys themselves will be anonymous. I will delete the survey and its contents 7 years after the MA thesis has been completed and accepted.

Where will the data be stored? Will they be stored under lock and key? Will electronic files be password protected?

The electronic files will be password protected.

Who will have access to the data?

The only person who will have access to the data is the researcher: Stacie Sivyer

When will the raw data be destroyed (paper questionnaires, cassettes of interviews, etc.)?

The surveys will be deleted after 7 years.

How will results be **disseminated**?

The survey and e-data collected will be deleted after 7 years.

4. COMMITMENT OF THE SUPERVISOR

As the Supervisor of this research project, I have reviewed the above ethical aspects of the project and have also reviewed the Consent Form. I attest that the information contained in these forms has been provided in good faith by

Stacie Sivyer

Name of the Supervisor: Helene Mathieu

Signature:

Date:

Appendix D

Teacher/ Respondent Consent Form

The Consent Form:

Dear colleagues welcome back to another year of teaching!

The following document is a link to a *Survey Monkey* questionnaire, which will be used to complete my (Stacie Sivyer) MA Thesis for the *University du Sherbrooke's* **MTP program**. The study is to explore the connections between various teacher demographics, preferred teaching methods, and epistemic beliefs- beliefs about learning and knowledge. It would be greatly appreciated if you could participate in my graduate studies by completing the 3 part survey.

The due date to complete the survey is Saturday September 30, 2017.

In order to ensure both your consent to participate in this study, read to and agree to the initial consent form. Your responses will be anonymous, as the survey does not request your name, and I will be the only one who can view the data.

I, _____ have read the above information regarding participation in this study. I hereby give permission to Stacie Sivyer to use the responses in the survey I have completed towards her MA Ed, for the University of Sherbrooke and the MTP. I understand that this survey is anonymous and, that there will be no follow-up questions.

Signature:

Date:

Appendix E

The Survey- DRAFT

Part 1- Teacher Demographics

1a. What is your identified gender? *Male / Female*

2a. In what branch of CEGEP do you teach?
Two-year Pre-University Program / Three-year Career Program

2b. In what Program do you teach:
Social Science / Liberal Arts / Science / Commerce / Visual Arts /
Accounting and Management Technology / Computer Science / Early Child Care and Education / Electronics and Information Technology / Hotel and Restaurant Management / New Media and Publication Design / Nursing / Special Care Counseling / Tourism

3a. How many years have you taught in this discipline?

1- Novice- *0-2 years of teaching experience,*
2- Amateur- *3-7 years,*
3- Intermediate- *8-15 years,*
4- Expert- *15-25 years,*
5- Master Expert- *26+ years of teaching experience*.

3b. Do you have any other type of teaching experience? If so what, and how much?

1. *Teacher- Assistant in Grad School –*
   *1b. If yes, what was your role: Proctoring, Marking, Data Research, Consulting with students, Other:*_____
2. *Camp counselor / coach / sports instructor*
3. *Peer / Professional Tutor*
4. *Other* _____

3c. What is your educational background that prepared you for teaching in this discipline? (I.e. What degrees/ diploma/ academic certificates do you have)?

1- *Novice*- Less than a Bachelor's degree in the field,
2- *Amateur*- A BA in the field you teach,
3- *Intermediate*- More than 1 BA in the field that you teach AND another BA in a similar discipline.
4- *Expert*- A Masters in the field that you teach,
5- *Master Expert*- A PhD in the field they teach.

3d. What other education do you have that is not specific to your discipline (if not already included above)?
Open Ended- Question

3e. What other work related experience do you have that is relevant to teaching your discipline?

1. Novice- *Short term co-op or apprenticing in the field as a student*
2. Amateur- *Internship in the field as a student*
3. Intermediate- *Participation in the work place for less than a year in your field*
4. Expert- *Participation in the work place for less than 5 years but more than 1year in your field*
5. Master-Expert- *Participation in the work place for than 5 years in your field*
6. Other _____

3f. what sort of professional development have you done relative to the subject or discipline that you teach?

1. Novice- *I read articles and books on the subjects of my field*
2. Amateur- *I have attended 1 day seminars or workshops on subjects in my field*
3. Intermediate- *I have attended multi-day seminars on subjects taught in my field*
4. Expert- *I have given workshops, lectures, seminars, or written articles on subjects taught in my field*

5. Master-Expert- *I have written books led conferences on subjects in my field*
6. Other _____

3g. What sort of professional development have you done relative to teaching practices or pedagogy?

1- Novice- *Minimal- mostly mandatory PD Days,*
2- Amateur- *PD Workshops that last more than one day*
3- Intermediate- *Has taken some pedagogical professional development courses, or multi day seminars,*
4- Expert- *Has a certificate in pedagogical education,*
5- Master Expert- *has a diploma or higher in pedagogical education.*

Part 2- Describe your Preferred Teaching Method.

4a. Use a metaphor to describe your philosophy on teaching: Elements of your metaphor must include aspects such as: Your role as teacher, the role of the student, what the best learning environment is, and how learning occurs.

Teaching is like…..

4b. Explain your metaphor. In doing so, please make sure that you indicate: ***Your role as teacher, the role of the student, what the best learning environment is,*** *and* ***how learning occurs.***

Part 3- Survey on Personal Epistemic Beliefs.

Taken from: Lee, J., Zhang, Z., Song, H., & Huang, X. (2013).

For the following Likert scale, please use 1 as totally agree and 5 as totally disagree.

(Epistemic Belief #1- Knowledge as Innate/ Fixed Ability)

1. There is not much you can do to make yourself smarter as your ability is fixed at birth.

1……..2……..3……..4……5……

2. Our abilities to learn are fixed at birth.

1……..2……..3……..4……5……

3. One's innate ability limits what one can do.

1……..2……..3……..4……5……

4. Some people are born good learners; others are just stuck with limited ability.

1……..2……..3……..4……5……

5. Some children are born incapable of learning well in certain subjects.

1……..2……..3……..4……5……

6. The ability to learn is innate/ inborn.

1……..2……..3……..4……5……

7. Students who begin school with "average" ability remain "average" throughout school.

1……..2……..3……..4……5……

8. The really smart students do not have to work hard to do well in school.

1……..2……..3……..4……5……

(Epistemic Belief #2- Learning Effort/ Process)

9. How much you get from learning depends mostly on your effort.

1……..2……..3……..4……5……

10. Getting ahead takes a lot of work.

1……..2……..3……..4……5……

11. If one tries hard enough, then one will understand the course material.

1……..2……..3……..4……5……

(Epistemic Belief #3- Authority/ Expert Knowledge)

12. If scientists try hard enough, they can find the truth to almost anything.

1……..2……..3……..4……5……

13. Anyone can figure out difficult concepts if one works hard enough.

1……..2……..3……..4……5……

14. I believe there should exist a teaching method applicable to all learning situations.

1……..2……..3……..4……5……

15. Scientific knowledge is certain and does not change.

1……..2……..3……..4……5……

(Epistemic Belief #4- Traditional Conception of Teaching (Information Transmission Paradigm))

16. The traditional/lecture method for teaching is best because it covers more information/knowledge.

1……..2……..3……..4……5……

17. It is best if teachers exercise as much authority as possible in the classroom.

1……..2……..3……..4……5……

18. Good teaching occurs when there is mostly teacher talk in the classroom.

1……..2……..3……..4……5……

19. Learning mainly involves absorbing as much information as possible.

1……..2……..3……..4……5……

20. Students have to be called on all the time to keep them under control.

1……..2……..3……..4……5……

21. Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it.

1……..2……..3……..4……5……

22. A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves.

1……..2……..3……..4……5……

23. No learning can take place unless students are controlled.

1……..2……..3……..4……5……

24. Teachers should have control over what students do all the time.

1……..2……..3……..4……5……

25. Learning to teach simply means practicing the ideas from lectures without questioning them.

1……..2……..3……..4……5……

26. I have really learned something when I can remember it later.

1……..2……..3……..4……5……

27. Teaching is simply telling, presenting or explaining subject matter.

1……..2……..3……..4……5……

28. The major role of a teacher is to transmit knowledge to students.

1……..2……..3……..4……5……

29. Learning occurs primarily from drilling and practice.

1……..2……..3……..4……5……

(Epistemic Belief #5- Constructivist Conception (Constructivist Paradigm))

30. It is important that a teacher understand the feelings of the students.

1……..2……..3……..4……5……

31. Good teachers always encourage students to think for answers themselves.

1……..2……..3……..4……5……

32. Learning means students have ample opportunities to explore, discuss and express their ideas.

1……..2……..3……..4……5……

33. In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact.

1……..2……..3……..4……5……

34. Every child is unique or special and deserves an education tailored to his or her particular needs.

1……..2……..3……..4……5……

35. Effective teaching encourages more discussion and hands on activities for students.

1……..2……..3……..4……5……

36. The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication.

1……..2……..3……..4……5……

37. Instruction should be flexible enough to accommodate individual differences among students.

1……..2……..3……..4……5……

38. Different objectives and expectations in learning should be applied to different students.

1……..2……..3……..4……5……

39. Students should be given many opportunities to express themselves.

1……..2……..3……..4……5……

40. The ideas of students are important and should be carefully considered.

1……..2……..3……..4……5……

41. Good teachers always make their students feel important.

1……..2……..3……..4……5……

42. Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving.

1……..2……..3……..4……5……

43. In order to learn complex material, students need information presented to them in several different ways.

1……..2……..3……..4……5……

44. If students can't apply what they learn to the real world, they don't really understand it.

1……..2……..3……..4……5……

45. It is important that students study real life problems that they are likely to encounter outside of the classroom.

1……..2……..3……..4……5……

46. I regularly incorporate student interest into lessons.

1……..2……..3……..4……5……

47. Students should help establish criteria on which their work will be assessed.

1……..2……..3……..4……5……

(Epistemic Belief #6- Focused instruction)

48. I am able to monitor the progress of all my students to my satisfaction.

1……..2……..3……..4……5……

49. I maintain a rapid pace of instruction in my classes.

1……..2……..3……..4……5……

50. In my class, disruptions of instructional time are minimized.

1……..2……..3……..4……5……

(Epistemic Belief #1- Flexible Grouping Practices)

51. I frequently group students according to different levels of academic ability.

1……..2……..3……..4……5……

52. Student groupings in my class depend on student need.

1……..2……..3……..4……5……

53. Student groupings in my class depend on my instructional purposes.

1……..2……..3……..4……5……

Appendix F

Raw Coding & Data

The following section reviews each of the 28 possible comparable associations (56 is you include all respondents as well as the comparison of novice and experts only). This section in organized such that the four types of teacher experience are grouped one after the other. Within each grouping, each experience is compared with each of the seven epistemic belief. Thus it goes: Years of Teaching Experience (YTE) and Epistemic belief #1; Years of Teaching Experience (YTE) and Epistemic belief #2,…, for all 28 (56) combinations.

For each of the 28 comparisons:

1. The Belief Statements. A list of all the epistemic belief statements that appeared per belief as found in the survey.

2. Respondent Distribution by ID number; Expected and Observed Frequency Tables. The first table displays the distribution of the respondent's answers using their ID number and whether they were defined as a novice, intermediate, or expert for the teacher experience in question. Please note that for epistemic beliefs #1, #3, #4, and #6 an inversion of coding took place prior to creating the distribution tables (which is why the ranking is by Low/Mid/High belief sophistication rather than by numeric average). The second table uses the distribution found in Table #1 in order to determine the expected frequency of the respondent's answers. The left side of Table #2 considers the expected distribution of all respondents, and the right side specifically compares only the novice and experts of the group. Finally, the third table details the observed frequency, of all respondents on the left, and the observed frequency of only the novice and experts on the right.

3. The fourth table uses a chi-square frequency distribution algorithm in order to compare the answers the expected and observed tables detailed in tables #2 and #3. Using $\alpha \leq 0.05$ as a threshold to identify whether a significant association was present and whether the null hypothesis was accepted or rejected.

1. Years of Teaching Experience and Epistemic belief #1- Knowledge is Innate/ Fixed at Birth

1.1 The Belief Statements.

This was the first of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: There is not much you can do to make yourself smarter as your ability is fixed at birth; One's innate ability limits what one can do; Some children are born incapable of learning well in certain subjects.; Students who begin school with "average" ability remain "average" throughout school; and finally The really smart students do not have to work hard to do well in school.

1.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F1. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #1- Knowledge is Innate/ Fixed at birth

ALL RESPONDENTS Distribution by Respondent ID number	LOW	MID	HIGH	TOTAL
Novice	0	4	7,8,9,14,15,29,34	**8**
Intermediate	0	17,27,28	1,3,5,6,10,11,16,19,20,21,22,23,24,30,32	**18**
Expert	2	18,33	12,13,25,26,31,35	**9**
Total	**1**	**6**	**28**	**35**

TABLE F1. 2

Frequency Expected- YTE & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.228	1.371	6.4	**8**	Novice	0.470	1.411	6.117	**8**
Intermediate	0.514	3.085	14.4	**18**					
Expert	0.257	1.542	7.2	**9**	Expert	0.529	1.588	6.882	**9**
Total	**1**	**6**	**28**	**35**		**1**	**3**	**13**	**17**

TABLE F1. 3

Frequency Observed- YTE & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1	7	**8**	Novice	0	1	7	**8**
Intermediate	0	3	15	**18**					
Expert	1	2	6	**9**	Expert	1	2	6	**9**
Total	**1**	**6**	**28**	**35**		**1**	**3**	**13**	**17**

1.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F1. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.491917**	P-Value **0.507599424**
H0- Null hypothesis accepted, p-value is more than 0.05	**H0- Null hypothesis accepted**, p-value is more than 0.05

2. Years of Teaching Experience & Epistemic Belief #2- Learning takes Effort/ Is a Process

2.1 The Belief Statements.

The belief statements were: How much you get from learning depends mostly on your effort; Getting ahead takes a lot of work; that if one tries hard enough, then one will understand the course material.

2.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F2. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS	LOW	MID	HIGH	
Novice	9	8,15,	4,7,14,29,34	**8**
Intermediate	3	1,6,16,17,19,24,28	5,10,11,20,21,22,23,27,30,32	**18**
Expert	0	18,35	2,12,13,25,26,31,33	**9**
Total	**2**	**11**	**22**	**35**

TABLE F2. 2

Frequency Expected: YTE & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.457	2.514	5.028	**8**	Novice	0.470	1.882	5.647	**8**
Intermediate	1.028	5.657	11.314	**18**					
Expert	0.514	2.828	5.657	**9**	Expert	0.529	2.11	6.352	**9**
Total	**2**	**11**	**22**	**35**		**1**	**4**	**12**	**17**

TABLE F2. 3

Frequency Observed: YTE & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS					NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	2	5	**8**	Novice	1	2	5	**8**
Intermediate	1	7	10	**18**					
Expert	0	2	7	**9**	Expert	0	2	7	**9**
Total	**2**	**11**	**22**	**35**		**1**	**4**	**12**	**17**

2.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F2. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.681136889** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.527573233** **H0- Null hypothesis accepted**, p-value is more than 0.05

3. Years of Teaching Experience & Epistemic Belief #3- Knowledge comes from Authority/ Experts

3.1 The Belief Statements.

This was the second of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: If scientists try hard enough, they can find the truth to almost anything; anyone can figure out difficult concepts if one works hard enough; I believe there should exist a teaching method applicable to all learning situations; scientific knowledge is certain and does not change.

3.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F3. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	7,15,34	4,8,9,14,29	8
Intermediate	0	10,11,21,23,24,30	1,3,5,6,16,17,19,20,22,27, 28,32	
Expert	31	2,25,35	12,13,18,26,33	
Total	1	12	22	35

TABLE F3. 2

Frequency Expected: YTE & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.228	2.742	5.028	**8**	Novice	0.470	2.823	4.705	**8**
Intermediate	0.514	4.5	11.314	**18**					
Expert	0.257	3.085	5.657	**9**	Expert	0.529	3.17	5.2941	**9**
Total	**1**	**12**	**22**	**35**		**1**	**6**	**10**	**17**

TABLE F3. 3

Frequency Observed: YTE & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	3	5	8	Novice	0	3	5	**8**
Intermediate	0	6	12	18					
Expert	1	3	5	9	Expert	1	3	5	**8**
Total	**1**	**12**	**22**	**35**		**1**	**6**	**10**	**9**

3.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F3. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.472813096** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.623614916** **H0- Null hypothesis accepted**, p-value is more than 0.05

4. Years of Teaching Experience & Epistemic Belief #4- Info-Tran IT/TF as a Learning Paradigm

4.1 The Belief Statements.

This was the third of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: The traditional/lecture method for teaching is best because it covers more information/knowledge; It is best if teachers exercise as much authority as possible in the classroom; Good teaching occurs when there is mostly teacher talk in the classroom; Learning mainly involves absorbing as much information as possible; Students have to be called on all the time to keep them under control; Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it; A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves; No learning can take place unless students are controlled; Teachers should have control over what students do all the time; Learning to teach simply means practicing the ideas from lectures without questioning them; I have really learned something when I can remember it later; Teaching is simply telling, presenting or explaining subject matter; The major role of a teacher is to transmit knowledge to students; Learning occurs primarily from drilling and practice.

2.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F4. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	4		7,8,9,14,15,29,34	**8**
Intermediate	1	16,27,28,30	3,5,6,10,11,17,19,20,21,22,23,24,32	**18**
Expert	0	12,25,26	2,13,18,31,33,35	**9**
Total	**2**	**7**	**26**	**35**

TABLE F4. 2

Frequency Expected: YTE & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.457	1.6	5.942	**8**	Novice	0.470	1.411	6.117	**8**
Intermedia te	1.028	3.6	13.371	**18**					
Expert	0.514	1.8	6.685	**9**	Expert	0.529 4	1.588	6.882	**9**
Total	**2**	**7**	**26**	**35**		**1**	**3**	**13**	**17**

TABLE F4. 3

Frequency Observed: YTE & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	0	7	**8**	Novice	1	0	7	**8**
Intermedia te	1	4	13	**18**					
Expert	0	3	6	**9**	Expert	0	3	6	**9**
Total	**2**	**7**	**26**	**35**		**1**	**3**	**13**	**17**

4.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F4. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	**NOVICE/ EXPERTS ONLY**
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.423485284**	P-Value **0.133183735**
H0- Null hypothesis accepted, p-value is more than 0.05	**H0- Null hypothesis accepted**, p-value is more than 0.05

5. Years of Teaching Experience & Epistemic Belief #5- Constructivism as a Learning Paradigm

5.1 The Belief Statements.

The belief statements were: It is important that a teacher understand the feelings of the students; Good teachers always encourage students to think for answers themselves; Learning means students have ample opportunities to explore, discuss and express their ideas; In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact; Every child is unique or special and deserves an education tailored to his or her particular needs; Effective teaching encourages more discussion and hands on activities for students; The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication; Instruction should be flexible enough to accommodate individual differences among students; Different objectives and expectations in learning should be applied to different students; Students should be given many opportunities to express themselves; The ideas of students are important and should be carefully considered; Good teachers always make their students feel important; Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving; In order to learn complex material, students need information presented to them in several different ways; If students can't apply what they learn to the real world, they don't really understand it; It is important that students study real life problems that they are likely to encounter outside of the classroom; I regularly incorporate student interest into lessons; Students should help establish criteria on which their work will be assessed.

5.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F5. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	4	7,8.9,14,15,29,34	**8**
Intermediate	0	6,11,20,27,28,30	1,3,5,10,16,17,19,21,22,23,24,32	**18**
Expert	0	26	2,12,13,18,25,31,33,35	**9**
Total	**0**	**8**	**27**	**35**

TABLE F5. 2

Frequency Expected: YTE & Epistemic Belief #5- Constructivism as a Learning Paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1.828	6.171	8	Novice	0	0.941	7.058	**8**
Intermediate	0	4.114	19.028	18					
Expert	0	2.057	6.942	9	Expert	0	1.058	7.941	**9**
Total	**0**	**8**	**27**	**35**		**0**	**2**	**15**	**17**

TABLE F5. 3

Frequency Observed: YTE & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1	7	8	Novice	0	1	7	**8**
Intermediate	0	6	12	18					
Expert	0	1	8	9	Expert	0	1	8	**9**
Total	**0**	**8**	**27**	**35**		**0**	**2**	**15**	**17**

5.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F5. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.097718311**	P-Value **0.929308326**
H0- Null hypothesis accepted, p-value is more than 0.05	**H0- Null hypothesis accepted**, p-value is more than 0.05

6. Years of Teaching experience & Epistemic Belief #6- Focused Instruction

6.1 The Belief Statements.

This was the last epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: I am able to monitor the progress of all my students to my satisfaction; I maintain a rapid pace of instruction in my classes; in my class, disruptions of instructional time are minimized.

6.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F6.1 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	4,7,14,29	8,9,15,34	**8**
Intermediate	5,22,23,27	3,6,11,20,21,30,32	1,10,16,17,19,24,28	**18**
Expert	0	2,12,13,18,26,31,33,35	25	**9**
Total	**4**	**19**	**12**	**35**

TABLE F6.1 2

Frequency Expected: YTE & Epistemic Belief #6- Focused Instruction

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.914	4.342	2.742	8	Novice	0	5.647	2.352	**8**
Intermediate	2.057	9.771	6.171	18					
Expert	1.028	4.885	3.085	9	Expert	0	6.352	2.647	**9**
Total	**4**	**19**	**12**	**35**		**0**	**12**	**5**	**17**

TABLE F6.1 3

Frequency Observed: YTE & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	4	4	8	Novice	0	4	4	**8**
Intermediate	4	7	7	18					
Expert	0	8	1	9	Expert	0	8	1	**9**
Total	**4**	**19**	**12**	**35**		**0**	**12**	**5**	**17**

6.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F6.1 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.069806386** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.079008271** **H0- Null hypothesis accepted**, p-value is more than 0.05

7. Years of Teaching Experience & Epistemic Belief #7- Flexible Grouping Practice

7.1 The Belief Statements.

The belief statements were: I frequently group students according to different levels of academic ability; student groupings in my class depend on student need; and, student groupings in my class depend on my instructional purposes.

7.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F7. 1

Respondent Distribution by ID numbers: YTE & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	8,9	4,7,14,15,29,34	0	**8**
Intermediate	6,16,20,27,28	1,3,10,11,17,19,21,22,23	5,24,30,32	**18**
Expert	18,25	12,13,26,33	2,31,35	**9**
Total	**9**	**19**	**7**	**35**

TABLE F7. 2

Frequency Expected: YTE & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	2.057	4.342	1.6	8	Novice	1.882	4.705	1.411	**8**
Intermediate	4.628	9.771	3.6	18					
Expert	2.314	4.885	1.8	9	Expert	2.117	5.294	1.588	**9**
Total	**9**	**19**	**7**	**35**		**4**	**10**	**3**	**17**

TABLE F7. 3

Frequency Observed: YTE & Epistemic Belief#7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	2	6	0	8	Novice	2	6	0	**8**
Intermediate	5	9	4	18					
Expert	2	4	3	9	Expert	2	4	3	**9**
Total	**9**	**19**	**7**	**35**		**4**	**10**	**3**	**17**

7.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F7. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.497555964** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.18704821** **H0- Null hypothesis accepted**, p-value is more than 0.05

8. Content Knowledge & Epistemic Belief #1- Knowledge is Innate/ Fixed at /Birth

8.1 The Belief Statements.

This was the first of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: There is not much you can do to make yourself smarter as your ability is fixed at birth; One's innate ability limits what one can do; Some children are born incapable of learning well in certain subjects.; Students who begin school with "average" ability remain "average" throughout school; and finally The really smart students do not have to work hard to do well in school.

8.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F8. 1

Respondent Distribution by ID numbers: CK & Epistemic Belief #1- Knowledge is Innate/ Fixed at birth-

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	4	5,7,13,14,31,32,34,35	**9**
Intermediate	2	18	3,8,9,10,15,16,19,20,21,23,24,25,29,30	**16**
Expert	0	17,27,28,33	1,6,11,12,22,26	**10**
Total	**1**	**6**	**28**	**35**

TABLE F8. 2

Frequency Expected: CK & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.257	1.542	7.2	9	Novice	0.257	1.542	7.2	**9**
Intermediate	0.457	2.742	12.8	16					
Expert	0.285	1.714	8	10	Expert	0.285	1.714	8	**10**
Total	**1**	**6**	**28**	**35**		**0**	**5**	**14**	**19**

TABLE F8. 3

Frequency Observed: CK & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1	8	9	Novice	0	1	8	**9**
Intermediate	1	1	14	16					
Expert	0	4	6	10	Expert	0	4	6	**10**
Total	**1**	**6**	**28**	**35**		**0**	**5**	**14**	**19**

8.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F8. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.182275447** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.112456906** **H0- Null hypothesis accepted**, p-value is more than 0.05

9. Content Knowledge & Epistemic Belief #2- Learning takes Effort/ Is a Process

9.1 The Belief Statements.

The belief statements were: How much you get from learning depends mostly on your effort; Getting ahead takes a lot of work; that if one tries hard enough, then one will understand the course material.

9.2 Respondent Distribution by ID number; Expected and Observed Frequency.

Table F9. 1

Respondent Distribution by ID numbers: CK & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	35	4,5,7,13,14,31,32,34	**9**
Intermediate	9	8,15,16,18,19,24	2,3,10,20,21,23,25,29,30	**16**
Expert	0	1,6,17,28	11,12,22,26,27,33	**10**
Total	**1**	**11**	**23**	**35**

TABLE F9. 2

Frequency Expected: CK & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.257	2.828	5.914	9	Novice	0.257	2.828	5.914	**9**
Intermediate	0.457	5.028	10.514	16					
Expert	0.285	3.14	6.571	10	Expert	0.285	3.14	6.571	**10**
Total	**1**	**11**	**23**	**35**		**0**	**5**	**14**	**19**

TABLE F9. 3

Frequency Observed: *CK & Epistemic Belief #2- Learning takes Effort/ Is a Process*

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1	8	9	Novice	1	8	9	**1**
Intermediate	1	6	9	16					
Expert	0	4	6	10	Expert	0	4	6	**10**
Total	**1**	**11**	**23**	**35**		**0**	**5**	**14**	**19**

9.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F9. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.434551402** **H0- Null hypothesis accepted**, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.253604154** **H0- Null hypothesis accepted**, p-value is more than 0.05

10. Content Knowledge & Epistemic Belief #3- Knowledge comes from Authority/ Experts

10.1 The Belief Statements.

This was the second of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: If scientists try hard enough, they can find the truth to almost anything; anyone can figure out difficult concepts if one works hard enough; I believe there should exist a teaching method applicable to all learning situations; scientific knowledge is certain and does not change.

10.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F10. 1

Respondent Distribution by ID numbers: Content Knowledge & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	4		5,7.13,14,31,32,34,35	**9**
Intermediate		2,16,25,30	3,8,9,10,15,18,19,20,21,23,24,29	**16**
Expert	1	12,26,27,28	6,11,17,22,33	**10**
Total	**2**	**8**	**25**	**35**

TABLE F10. 2

Frequency Expected: CK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.514	2.057	6.428	9	Novice	0.257	3.6	5.142	**9**
Intermediate	0.914	3.657	11.428	16					
Expert	0.571	2.285	7.142	10	Expert	0.285	4	5.714	**10**
Total	**2**	**8**	**25**	**35**		**1**	**5**	**13**	**19**

TABLE F10. 3

Frequency Observed: CK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	4	4	9	Novice	1	4	4	**9**
Intermediate	0	9	7	16					
Expert	0	1	9	10	Expert	0	1	9	**10**
Total	**1**	**14**	**20**	**35**		**1**	**5**	**13**	**19**

10.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F10. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	**NOVICE/ EXPERTS ONLY**
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05
P-Value **0.064037282** H0- Null hypothesis accepted, p-value is more than 0.05	P-Value **0.032234363** **H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.**

11. Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a Learning Paradigm

11.1 The Belief Statements.

This was the third of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: The traditional/lecture method for teaching is best because it covers more information/knowledge; It is best if teachers exercise as much authority as possible in the classroom; Good teaching occurs when there is mostly teacher talk in the classroom; Learning mainly involves absorbing as much information as possible; Students have to be called on all the time to keep them under control; Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it; A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves; No learning can take place unless students are controlled; Teachers should have control over what students do all the time; Learning to teach simply means practicing the ideas from lectures without questioning them; I have really learned something when I can remember it later; Teaching is simply telling, presenting or explaining subject matter; The major role of a teacher is to transmit knowledge to students; Learning occurs primarily from drilling and practice.

11.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F11. 1

Respondent Distribution by ID numbers: CK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	4	0	5,7.13,14,31,32,34,35	**9**
Intermediate	0	2,16,25,30	3,8,9,10,15,18,19,20,21,23,24,29	**16**
Expert	1	12,26,27,28	6,11,17,22,33	**10**
Total	**2**	**8**	**25**	**35**

TABLE F11. 2

Frequency Expected: Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.514	2.057	6.428	9	Novice	0.514	2.057	6.428	**9**
Intermedia te	0.914	3.657	11.428	16					
Expert	0.571	2.285	7.142	10	Expert	0.571	2.285	7.142	**10**
Total	**2**	**8**	**25**	**35**		**2**	**4**	**13**	**19**

TABLE F11. 3

Frequency Observed: CK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL	LOW
Novice	1	0	8	**9**	Novice	1	0	8	9	**1**
Intermediate	0	4	12	**16**						
Expert	1	4	5	**10**	Expert	1	4	5	10	**1**
Total	**2**	**8**	**25**	**35**		**2**	**4**	**13**	**19**	**2**

11.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

Table F11. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	**NOVICE/ EXPERTS ONLY**
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.190005653**	P-Value **0.076153823**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

12. Content Knowledge & Epistemic Belief #5- Constructivism as a Learning Paradigm

12.1 The Belief Statements.

The belief statements were: It is important that a teacher understand the feelings of the students; Good teachers always encourage students to think for answers themselves; Learning means students have ample opportunities to explore, discuss and express their ideas; In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact; Every child is unique or special and deserves an education tailored to his or her particular needs; Effective teaching encourages more discussion and hands on activities for students; The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication; Instruction should be flexible enough to accommodate individual differences among students; Different objectives and expectations in learning should be applied to different students; Students should be given many opportunities to express themselves; The ideas of students are important and should be carefully considered; Good teachers always make their students feel important; Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving; In order to learn complex material, students need information presented to them in several different ways; If students can't apply what they learn to the real world, they don't really understand it; It is important that students study real life problems that they are likely to encounter outside of the classroom; I regularly incorporate student interest into lessons; Students should help establish criteria on which their work will be assessed.

12.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F12. 1

Respondent Distribution by ID numbers: Content Knowledge & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	4,13	5,7,14,31,32,34,35	**9**
Intermediate	0	20,30	2,3,8,9,10,15,16,,18,19,21,23,24,25,29	**16**
Expert	0	6,11,26,27,28	1,12,17,22,33	**10**
Total	0	9	26	**35**

TABLE F12. 2

Frequency Expected: CK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0	2.314	6.685	9	Novice	0	2.314	6.685	**9**
Intermediate	0	4.114	11.885	16					
Expert	0	2.571	7.428	10	Expert	0	2.571	7.428	**10**
Total	**0**	**9**	**26**	**35**		**0**	**7**	**12**	**19**

TABLE F12. 3

Frequency Observed- CK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	2	7	9	Novice	0	2	7	**9**
Intermediate	0	2	14	16					
Expert	0	5	5	10	Expert	0	5	5	**10**
Total	**0**	**9**	**26**	**35**		**0**	**7**	**12**	**19**

12.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F12. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.099875159**	P-Value **0.076157119**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

13. Content Knowledge & Epistemic Belief #6- Focused Instruction

13.1 The Belief Statements.

This was the last epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: I am able to monitor the progress of all my students to my satisfaction; I maintain a rapid pace of instruction in my classes; in my class, disruptions of instructional time are minimized.

13.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F13. 1

Respondent Distribution by ID numbers: CK & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	5	4, 7, 13, 14, 31, 32, 35	34	**9**
Intermediate	3, 23	2, 18, 20, 21, 29, 30	8, 9, 10, 15, 16, 19, 24, 25	**16**
Expert	32	6, 11, 12, 26, 27, 33	1, 17, 28	**10**
Total	**4**	**19**	**12**	**35**

TABLE F13. 2

Frequency Expected: Content Knowledge & Epistemic Belief #6- Focused Instruction

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	1.028	4.885	3.085	9	Novice	1.028	4.885	3.085	**9**
Intermedia te	1.828	8.685	5.485	16					
Expert	1.142	5.428	3.428	10	Expert	1.142	5.428	3.428	**10**
Total	**4**	**19**	**12**	**35**		**2**	**13**	**4**	**19**

TABLE F13. 3

Frequency Observed: Content Knowledge & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	7	1	9	Novice	1	7	1	**9**
Intermediate	2	6	8	16					
Expert	1	6	3	10	Expert	1	6	3	**10**
Total	**4**	**19**	**12**	**35**		**2**	**13**	**4**	**19**

13.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F13. 4

Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.347794448**	P-Value **0.292714513**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

14. Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

14.1 The Belief Statements.

The belief statements were: I frequently group students according to different levels of academic ability; student groupings in my class depend on student need; and, student groupings in my class depend on my instructional purposes.

14.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F14. 1

Respondent Distribution by ID numbers: CK & Epistemic Belief #7- Flexible Grouping Practice.

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	4,7,13,14	5,31,32,34,35	**9**
Intermediate	8,9,16,18,20,25	3,10,15,19,21,23,29	2,24,30	**16**
Expert	6,27,28	1,11,12,17,22,26,33	0	**10**
Total	**9**	**18**	**8**	**35**

TABLE F14. 2

Frequency Expected- Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	**NOVICE / EXPERT ONLY**	LOW	MID	HIGH	TOTAL
Novice	2.314	4.628	2.057	9	Novice	2.314	4.628	2.057	**9**
Intermedia te	4.114	8.228	3.657	16					
Expert	2.571	5.142	2.285	10	Expert	2.571	5.142	2.285	**10**
Total	**9**	**18**	**8**	**35**		**3**	**11**	**5**	**19**

TABLE F14. 3

Frequency Observed- Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	4	5	9	Novice	0	4	5	**9**
Intermediate	6	7	3	16					
Expert	3	7	0	10	Expert	3	7	0	**10**
Total	**9**	**18**	**8**	**35**		**3**	**11**	**5**	**19**

14.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F14. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.028867799**	P-Value **0.0080775**
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	**H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.**

15. Pedagogical Content Knowledge & Epistemic Belief #1- Knowledge is Innate/ Fixed at Birth

15.1 The Belief Statements.

This was the first of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: There is not much you can do to make yourself smarter as your ability is fixed at birth; One's innate ability limits what one can do; Some children are born incapable of learning well in certain subjects.; Students who begin school with "average" ability remain "average" throughout school; and finally The really smart students do not have to work hard to do well in school.

15.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F15. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #1- Knowledge is Innate/ Fixed at birth

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	4	5,7,13,14,31,32,34,35	**13**
Intermediate	2	18	3,8,9,10,15,16,19,20,21,23,24,25,29,30	**8**
Expert	0	17,27,28,33	1,6,11,12,22,26	**14**
Total	**1**	**6**	**28**	**35**

TABLE F15. 2

Frequency Expected: PCK & Epistemic Belief #1 Knowledge is innate

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.371	2.228	10.4	**13**	Novice	0.481	1.925	10.592	**13**
Intermediate	0.228	1.371	6.4	**8**					
Expert	0.4	2.4	11.2	**14**	Expert	0.518	2.074	11.407	**14**
Total	**1**	**6**	**28**	**35**		**1**	**9**	**17**	**27**

TABLE F15. 3

Frequency Observed: *PCK & Epistemic Belief #1 Knowledge is innate*

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	3	9	13	Novice	1	3	9	**13**
Intermediate	0	2	6	8					
Expert	0	1	13	14	Expert	0	1	13	**14**
Total	**1**	**6**	**28**	**35**		**1**	**4**	**22**	**27**

15.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F15. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.467786746**	**P-Value 0.260028111**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

16. Pedagogical Content Knowledge & Epistemic Belief #2- Learning takes Effort/ Is a Process

16.1 The Belief Statements.

The belief statements were: How much you get from learning depends mostly on your effort; Getting ahead takes a lot of work; that if one tries hard enough, then one will understand the course material.

16.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F16. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	17	2,3,4,10,12,21,22,25,26,27,30,31	**13**
Intermediate	0	1,28,	14,23,29,32,33,34	**8**
Expert	9	6,8,15,16,18,19,24,35	5,7,11,13,20	**14**
Total	**1**	**11**	**23**	**35**

TABLE F16. 2

Frequency Expected: PCK & Epistemic Belief #2- Learning takes Effort

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.371	4.085	8.542	13	Novice	0.481	4.333	8.185	**13**
Intermediate	0.228	2.514	5.257	8					
Expert	0.4	4.4	9.2	14	Expert	0.518	4.666	8.814	**14**
Total	**1**	**11**	**23**	**35**		**1**	**9**	**17**	**27**

TABLE F16. 3

Frequency Observed: Pedagogical Content Knowledge & Epistemic Belief #2- Learning takes Effort

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	1	12	13	Novice	0	1	12	**13**
Intermediate	0	2	6	8					
Expert	1	8	5	14	Expert	1	8	5	**14**
Total	**1**	**11**	**23**	**35**		**1**	**9**	**17**	**27**

16.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F16. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.035628673** **H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.**	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.009549557** **H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.**

17. Pedagogical Content Knowledge & Epistemic Belief #3- Knowledge comes from Authority/ Experts

17.1 The Belief Statements.

This was the second of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: If scientists try hard enough, they can find the truth to almost anything; anyone can figure out difficult concepts if one works hard enough; I believe there should exist a teaching method applicable to all learning situations; scientific knowledge is certain and does not change.

17.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F17. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	31	2,3,10,21,25,30	4,12,17,22,26,27	**13**
Intermediate	0	23,34	1,14,28,29,32,33	**8**
Expert	0	5,7,11,15,24,35	6,8,9,13,16,18,19,20	**14**
Total	**1**	**14**	**20**	**35**

TABLE F17. 2

Frequency Expected: PCK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.371	5.2	7.428	13	Novice	0.481	6.5	6.740	**13**
Intermediate	0.228	8.145	4.571	8					
Expert	0.4	5.6	8	14	Expert	0.518	6.222	7.259	**14**
Total	**1**	**14**	**20**	**35**		**1**	**12**	**14**	**27**

TABLE F17. 3

Frequency Observed: PCK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	6	6	13	Novice	1	6	6	**13**
Intermediate	0	2	6	8					
Expert	0	6	8	14	Expert	0	6	8	**14**
Total	**1**	**14**	**20**	**35**		**1**	**12**	**14**	**27**

17.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F17. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.633016026**	P-Value **0.527211492**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

18. Pedagogical Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a Learning Paradigm

18.1 The Belief Statements.

This was the third of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: The traditional/lecture method for teaching is best because it covers more information/knowledge; It is best if teachers exercise as much authority as possible in the classroom; Good teaching occurs when there is mostly teacher talk in the classroom; Learning mainly involves absorbing as much information as possible; Students have to be called on all the time to keep them under control; Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it; A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves; No learning can take place unless students are controlled; Teachers should have control over what students do all the time; Learning to teach simply means practicing the ideas from lectures without questioning them; I have really learned something when I can remember it later; Teaching is simply telling, presenting or explaining subject matter; The major role of a teacher is to transmit knowledge to students; Learning occurs primarily from drilling and practice.

18.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F18. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	4	2,12,25,26,27,30	3,10,17,21,22,31	**13**
Intermediate	1	28	14,23,29,32,33,34	**8**
Expert	0	16	5,6,7,8,9,11,13,15,18,19,20,24,35	**14**
Total	**2**	**8**	**25**	**35**

TABLE F18. 2

Frequency Expected: Pedagogical Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.742	2.971	9.285	13	Novice	0.481	3.370	9.148	13
Intermediate	0.457	1.828	5.714	8					
Expert	0.8	3.2	10	14	Expert	0.518	3.629	9.851	14
Total	**2**	**8**	**25**	**35**		**1**	**7**	**19**	**27**

TABLE F18. 3

Frequency Observed: Pedagogical Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	6	6	13	Novice	1	6	6	**13**
Intermediate	1	1	6	8					
Expert	0	1	13	14	Expert	0	1	13	**14**
Total	**2**	**8**	**25**	**35**		**1**	**7**	**19**	**27**

18.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F18. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.072342337**	P-Value **0.028394637**
H0- Null hypothesis accepted, p-value is more than 0.05	**H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis**

19. Pedagogical Content Knowledge & Epistemic Belief #5- Constructivism as a Learning Paradigm

19.1The Belief Statements.

The belief statements were: It is important that a teacher understand the feelings of the students; Good teachers always encourage students to think for answers themselves; Learning means students have ample opportunities to explore, discuss and express their ideas; In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact; Every child is unique or special and deserves an education tailored to his or her particular needs; Effective teaching encourages more discussion and hands on activities for students; The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication; Instruction should be flexible enough to accommodate individual differences among students; Different objectives and expectations in learning should be applied to different students; Students should be given many opportunities to express themselves; The ideas of students are important and should be carefully considered; Good teachers always make their students feel important; Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving; In order to learn complex material, students need information presented to them in several different ways; If students can't apply what they learn to the real world, they don't really understand it; It is important that students study real life problems that they are likely to encounter outside of the classroom; I regularly incorporate student interest into lessons; Students should help establish criteria on which their work will be assessed.

19.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F19. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	4,26,27,30	2,3,10,12,17,21,22,25,31	**13**
Intermediate	0	28	1,14,23,29,32,33,34	**8**
Expert	0	6,11,20	5,7,8,9,13,15,16,18,19,24,35	**14**
Total	**0**	**8**	**27**	**35**

TABLE F19. 2

Frequency Expected: PCK & Constructivism as a learning paradigm

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE/ EXPERT ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	2.971	10.028	13	Novice	0	3.370	9.629	**13**
Intermediate	0	1.828	6.171	8					
Expert	0	3.2	10.8	14	Expert	0	3.629	10.370	**14**
Total	**0**	**8**	**27**	**35**		**0**	**7**	**20**	**27**

TABLE F19. 3

Frequency Observed: Pedagogical Content Knowledge & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE/ EXPERTS ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	4	9	13	Novice	0	4	9	**13**
Intermediate	0	1	7	8					
Expert	0	3	11	14	Expert	0	3	11	**14**
Total	**0**	**8**	**27**	**35**		**0**	**7**	**20**	**27**

19.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F19. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.617413692**	P-Value **0.579996573**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

20. Pedagogical Content Knowledge & Epistemic Belief #6- Focused Instruction

20.1 The Belief Statements.

This was the last epistemic belief domain where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: I am able to monitor the progress of all my students to my satisfaction; I maintain a rapid pace of instruction in my classes; in my class, disruptions of instructional time are minimized.

20.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F20. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	3,22	2,4,12,21,26,27,30,31	10,17,25	**13**
Intermediate	23	14,29,32,33	1,28,34	**8**
Expert	5,8	6,7,11,13,18,20,35	9,15,16,19,24	**14**
Total	**5**	**19**	**11**	**35**

TABLE F20. 2

Frequency Expected- PCK & Epistemic Belief #6- Focused Instruction

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	1.857	7.057	4.085	13	Novice	1.925	7.222	3.851	**13**
Intermedia te	1.142	4.342	2.514	8					
Expert	2	7.6	4.4	14	Expert	2.074	7.777	4.148	**14**
Total	**5**	**19**	**11**	**35**		**4**	**15**	**8**	**27**

TABLE F20. 3

Frequency Observed- PCK & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	2	8	3	13	Novice	2	8	3	**13**
Intermediate	1	4	3	8					
Expert	2	7	5	14	Expert	2	7	5	**14**
Total	**5**	**19**	**11**	**35**		**4**	**15**	**8**	**27**

20.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F20. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.952138882**	P-Value **0.767068961**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

21. Pedagogical Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

21.1 The Belief Statements. The belief statements were: I frequently group students according to different levels of academic ability; student groupings in my class depend on student need; and, student groupings in my class depend on my instructional purposes.

21.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F21. 1

Respondent Distribution by ID numbers: PCK & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	3,22	2,4,12,21,26,27,30,31	10,17,25	**13**
Intermediate	23	14,29,32,33	1,28,34	**8**
Expert	5,8	6,7,11,13,18,20,35	9,15,16,19,24	**14**
Total	**5**	**19**	**11**	**35**

TABLE F21. 2

Frequency Expected: Pedagogical Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	1.857	7.057	4.085	13	Novice	1.925	7.222	3.851	**13**
Intermediate	1.142	4.342	2.514	8					
Expert	2	7.6	4.4	14	Expert	2.074	7.777	4.148	**14**
Total	**5**	**19**	**11**	**35**		**4**	**15**	**8**	**27**

TABLE F21. 3

Frequency Observed: Pedagogical Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	2	8	3	13	Novice	2	8	3	**13**
Intermediate	1	4	3	8					
Expert	2	7	5	14	Expert	2	7	5	**14**
Total	**5**	**19**	**11**	**35**		**4**	**15**	**8**	**27**

21.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F21. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.952138882**	P-Value **0.767068961**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

22. Apprentice Content Knowledge & Epistemic Belief #1- Knowledge is Innate/ Fixed at Birth

22.1 The Belief Statements.

This was the first of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: There is not much you can do to make yourself smarter as your ability is fixed at birth; One's innate ability limits what one can do; Some children are born incapable of learning well in certain subjects.; Students who begin school with "average" ability remain "average" throughout school; and finally The really smart students do not have to work hard to do well in school.

22.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F22. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #1- Knowledge is Innate/ Fixed at birth

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	0	1,6,9,11,15,19,22,26,35	**9**
Intermediate	0	18,27,28,33	8,10,12,13,20,21,29	**11**
Expert	2	4,17	3,5,7,14,16,23,24,25,30,31,32,34	**15**
Total	**1**	**6**	**28**	**35**

TABLE F22. 2

Frequency Expected: Apprentice Content Knowledge & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPON-DENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE / EXPERT ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0.257	1.542	7.2	9	Novice	0.375	0.514	7.875	**9**
Intermediate	0.314	1.885	8.8	11					
Expert	0.428	2.571	12	15	Expert	0.625	0.857	13.125	**15**
Total	**1**	**6**	**28**	**35**		**1**	**2**	**21**	**24**

TABLE F22. 3

Frequency Observed: ACK & Epistemic Belief #1 Knowledge is innate / fixed at birth

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE/ EXPERTS ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	0	9	9	Novice	0	0	9	**9**
Intermediate	0	4	7	11					
Expert	1	2	12	15	Expert	1	2	12	**15**
Total	**1**	**6**	**28**	**35**		**1**	**2**	**21**	**24**

22.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F22. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	**NOVICE/ EXPERTS ONLY**
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05
P-Value **0.185266755** H0- Null hypothesis accepted, p-value is more than 0.05	P-Value **0.235129454** H0- Null hypothesis accepted, p-value is more than 0.05

23. Apprentice Content Knowledge & Epistemic Belief #2- Learning takes Effort/ Is a Process

23.1 The Belief Statements.

The belief statements were: How much you get from learning depends mostly on your effort; Getting ahead takes a lot of work; that if one tries hard enough, then one will understand the course material.

23.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F23. 1

Distribution by Respondent ID numbers: ACK & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	9	1,6,15,19,35	11,22,26	**9**
Intermediate	0	8,18,28	10,12,13,20,21,27,29,33	**11**
Expert	0	16,17,24	2,3,4,5,7,14,23,25,30,31,32,34	**15**
Total	**1**	**11**	**23**	**35**

TABLE F23. 2

Frequency Expected: Apprentice Content Knowledge & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.257	2.828	5.914	**9**	Novice	0.375	3	5.625	**9**
Intermediate	0.314	3.457	7.228	**11**					
Expert	0.428	4.714	9.857	**15**	Expert	0.625	5	9.375	**15**
Total	**1**	**11**	**23**	**35**		**1**	**8**	**15**	**24**

TABLE F23. 3

Frequency Observed: Apprentice Content Knowledge & Epistemic Belief #2- Learning takes Effort/ Is a Process

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE/ EXPERTS ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	1	5	3	**9**	Novice	1	5	3	**9**
Intermediate	0	3	8	**11**					
Expert	0	3	12	**15**	Expert	0	3	12	**15**
Total	**1**	**11**	**23**	**35**		**1**	**8**	**15**	**24**

23.3 P-Value determined. Null Hypothesis Rejected/ Accepted

TABLE F23. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	**NOVICE/ EXPERTS ONLY**
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.124520709**	**P-Value 0.056134763**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

24. Apprentice Content Knowledge & Epistemic Belief #3- Knowledge comes from Authority/ Experts

24.1 The Belief Statements.

This was the second of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: If scientists try hard enough, they can find the truth to almost anything; anyone can figure out difficult concepts if one works hard enough; I believe there should exist a teaching method applicable to all learning situations; scientific knowledge is certain and does not change.

24.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F24. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	0	11,15,35	1,6,9,19,22,26	**9**
Intermediate	0	10,21	8,12.13,18,20,27,28,29,33	**11**
Expert	31	2,3,5,7,23,24,25,30,34	4,14,16,17,32,	**15**
Total	**1**	**14**	**20**	**35**

TABLE F24. 2

Frequency Expected: ACK & Epistemic Belief # #3- Knowledge comes from Authority/ Experts

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.2571	3.6	5.142	9	Novice	0.375	4.5	4.125	**9**
Intermediate	0.314	4.4	6.285	11					
Expert	0.428	6	8.571	15	Expert	0.625	7.5	6.875	**15**
Total	**1**	**14**	**20**	**35**		**1**	**12**	**11**	**24**

TABLE F24. 3

Frequency Observed: ACK & Epistemic Belief #3- Knowledge comes from Authority/ Experts

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	0	3	6	9	Novice	0	3	6	**9**
Intermediate	0	2	9	11					
Expert	1	9	5	15	Expert	1	9	5	**15**
Total	**1**	**14**	**20**	**35**		**1**	**12**	**11**	**24**

24.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F24. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.13350557** H0- Null hypothesis accepted, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.251121553** H0- Null hypothesis accepted, p-value is more than 0.05

25. Apprentice Content Knowledge & Epistemic Belief #4- Info-Tran IT/TF as a Learning Paradigm

25.1 The Belief Statements.

This was the third of four epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: The traditional/lecture method for teaching is best because it covers more information/knowledge; It is best if teachers exercise as much authority as possible in the classroom; Good teaching occurs when there is mostly teacher talk in the classroom; Learning mainly involves absorbing as much information as possible; Students have to be called on all the time to keep them under control; Teaching is to provide students with accurate and complete knowledge rather than encourage then to discover it; A teacher's task is to correct learning misconceptions of students right away instead of verifying them for themselves; No learning can take place unless students are controlled; Teachers should have control over what students do all the time; Learning to teach simply means practicing the ideas from lectures without questioning them; I have really learned something when I can remember it later; Teaching is simply telling, presenting or explaining subject matter; The major role of a teacher is to transmit knowledge to students; Learning occurs primarily from drilling and practice.

25.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F25. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	1	26	6,9,11,15,19,22,35	**9**
Intermediate	0	12,27,28	8,10,13,18,20,21,29,33	**11**
Expert	4	2,16,25,30	3,5,7,14,17,23,24,31,32,34	**15**
Total	**2**	**8**	**25**	**35**

TABLE F25. 2

Frequency Expected: ACK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	0.514	2.057	6.428	9	Novice	0.75	1.875	6.375	**9**
Intermediate	0.628	2.514	7.857	11					
Expert	0.857	3.428	10.714	15	Expert	1.25	3.125	10.625	**15**
Total	**2**	**8**	**25**	**35**		**2**	**5**	**8**	**24**

TABLE F25. 3

Frequency Observed: ACK & Epistemic Belief #4- Info-Tran IT/TF as a learning paradigm

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	1	7	9	Novice	1	1	7	**9**
Intermediate	0	3	8	11					
Expert	1	4	10	15	Expert	1	4	10	**15**
Total	**2**	**8**	**25**	**35**		**2**	**5**	**17**	**24**

25.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F25. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.745976423**	P-Value **0.642522823**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

26. Apprentice Content Knowledge & Epistemic Belief #5- Constructivism as a Learning Paradigm

26.1 The Belief Statements.

The belief statements were: It is important that a teacher understand the feelings of the students; Good teachers always encourage students to think for answers themselves; Learning means students have ample opportunities to explore, discuss and express their ideas; In good classrooms, there is a democratic and free atmosphere that stimulates students to think and interact; Every child is unique or special and deserves an education tailored to his or her particular needs; Effective teaching encourages more discussion and hands on activities for students; The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication; Instruction should be flexible enough to accommodate individual differences among students; Different objectives and expectations in learning should be applied to different students; Students should be given many opportunities to express themselves; The ideas of students are important and should be carefully considered; Good teachers always make their students feel important; Students learn best when they are actively involved in exploring ideas, inventing, and trying out their own approaches to problem-solving; In order to learn complex material, students need information presented to them in several different ways; If students can't apply what they learn to the real world, they don't really understand it; It is important that students study real life problems that they are likely to encounter outside of the classroom; I regularly incorporate student interest into lessons; Students should help establish criteria on which their work will be assessed.

26.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F26. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	6,11,26	1,9,15,19,22,35	**9**
Intermediate	0	20,27,28	8,10,12,13,18,21,29,33	**11**
Expert	0	4,30	2,3,5,7,14,16,17,23,24,25,31,32,34	**15**
Total	**0**	**8**	**27**	**35**

TABLE F26. 2

Frequency Expected: ACK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPON-DENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE / EXPERT ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	2.057	6.942	9	Novice	0	1.875	7.125	**9**
Intermediate	0	2.514	8.485	11					
Expert	0	3.428	11.571	15	Expert	0	3.125	11.875	**15**
Total	**0**	**8**	**27**	**35**		**0**	**5**	**19**	**24**

TABLE F26. 3

Frequency Observed: ACK & Epistemic Belief #5- Constructivism as a learning paradigm

ALL RESPONDENTS	**LOW**	**MID**	**HIGH**	**TOTAL**	**NOVICE/ EXPERTS ONLY**	**LOW**	**MID**	**HIGH**	**TOTAL**
Novice	0	3	6	9	Novice	0	3	6	**9**
Intermediate	0	3	8	11					
Expert	0	2	13	15	Expert	0	2	13	**15**
Total	**0**	**8**	**27**	**35**		**0**	**5**	**19**	**24**

26.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F26. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship
H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.	H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis.
α 0.05	α 0.05
P-Value **0.483496327**	P-Value **0.242809091**
H0- Null hypothesis accepted, p-value is more than 0.05	H0- Null hypothesis accepted, p-value is more than 0.05

27. Apprentice Content Knowledge & Epistemic Belief #6- Focused Instruction

27.1 The Belief Statements.

This was the last epistemic belief domains where the numeric average of the domain clusters had to be inverted before entering the results into the distribution table such that prior to the inversion, a low score demonstrated high belief sophistication and a high score demonstrated low belief sophistication.

The belief statements were: I am able to monitor the progress of all my students to my satisfaction; I maintain a rapid pace of instruction in my classes; in my class, disruptions of instructional time are minimized.

27.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F27. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	22	6,11,26,35	1,9,15,19	**9**
Intermediate	0	12.13,18,20,21,27,29,33	8,10,28	**11**
Expert	3,5,23	2,4,7,14,30,31,32	16,17,24,25,34	**15**
Total	**4**	**19**	**12**	**35**

TABLE F27. 2

Frequency Expected: Apprentice Content Knowledge & Epistemic Belief #6- Focused Instruction

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	1.028	4.885	3.085	9	Novice	1.5	4.125	3.375	**9**
Intermediate	1.257	5.971	3.771	11					
Expert	1.714	8.142	5.142	15	Expert	2.5	6.875	5.625	**15**
Total	**4**	**19**	**12**	**35**		**4**	**11**	**9**	**24**

TABLE F27. 3

Frequency Observed- ACK & Epistemic Belief #6- Focused Instruction

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	1	4	4	9	Novice	1	4	4	**9**
Intermediate	0	8	3	11					
Expert	3	7	5	15	Expert	3	7	5	**15**
Total	**4**	**19**	**12**	**35**		**4**	**11**	**9**	**24**

27.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F27. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.453239389** H0- Null hypothesis accepted, p-value is more than 0.05	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.795363347** H0- Null hypothesis accepted, p-value is more than 0.05

28. Apprentice Content Knowledge & Epistemic Belief #7- Flexible Grouping Practice

28.1 The Belief Statements.

The belief statements were: I frequently group students according to different levels of academic ability; student groupings in my class depend on student need; and, student groupings in my class depend on my instructional purposes.

28.2 Respondent Distribution by ID number; Expected and Observed Frequency.

TABLE F28. 1

Respondent Distribution by ID numbers: ACK & Epistemic Belief #7- Use of Flexible Grouping Practices

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL
Novice	6,9	1,11,15,19,22,26	35	**9**
Intermediate	8,18,20,27,28	10,12,13,21,29,33	0	**11**
Expert	16,25	3,4,7,14,17,23	2,5,24,30,31,32,34	**15**
Total	**9**	**18**	**8**	**35**

TABLE F28. 2

Frequency Expected: ACK & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPON-DENTS	LOW	MID	HIGH	TOTAL	NOVICE / EXPERT ONLY	LOW	MID	HIGH	TOTAL
Novice	2.314	4.628	2.057	9	Novice	1.5	4.5	3	**9**
Intermediate	2.828	5.657	2.514	11					
Expert	3.857	7.714	3.428	15	Expert	2.5	7.5	5	**15**
Total	**9**	**18**	**8**	**35**		**4**	**12**	**8**	**24**

TABLE F28. 3

Frequency Observed: ACK & Epistemic Belief #7- Flexible Grouping Practice

ALL RESPONDENTS	LOW	MID	HIGH	TOTAL	NOVICE/ EXPERTS ONLY	LOW	MID	HIGH	TOTAL
Novice	2	6	1	9	Novice	2	6	1	**9**
Intermediate	5	6	0	11					
Expert	2	6	7	15	Expert	2	6	7	**15**
Total	**9**	**18**	**8**	**35**		**4**	**12**	**8**	**24**

28.3 P-Value determined. Null Hypothesis Rejected/ Accepted.

TABLE F28. 4

P- Value & Hypothesis Accepted/ Rejected

ALL RESPONDENTS	NOVICE/ EXPERTS ONLY
H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.037351015** **H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis**	H0: If the P-value is greater than α, do not reject the null hypothesis. No relationship H1- If the P-value is less than (or equal to) α, reject the null hypothesis in favor of the alternative hypothesis. α 0.05 P-Value **0.201896518** H0- Null hypothesis accepted, p-value is more than 0.05