



Organizational Structure of Graduate School Dissertation Introductions as Seen from a Highly Technical Discipline

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Abstract. This study aims to investigate whether graduate school dissertation introductions in mathematics programs adhere to the rhetorical structures commonly employed by refereed journals. Utilizing mixed methods, the research employed a quantitative approach but focused solely on simple frequency counts and a fishbowl draw. Textual analysis, a qualitative method, extensively examined and described the communicative intent of the data extracted from selected mathematics dissertation introductions. Intercoder reliability was used to ensure consistency and validity during initial coding of the data. The results revealed the organizational structure of the Ph.D. Mathematics dissertation introductions, analyzed textually, need to align with research scholarship in journal publications, following Swales' CARS model. However, this study acknowledges the limitation of focusing solely on one discipline, as it may not fully capture the characteristics of the qualitative population. Emphasizing the importance of possessing grounded knowledge and skills in crafting a well-structured research introduction, this study underscores its significance for submission to refereed index journals and for eventual publication approval. This inquiry is prompted by the scarcity of literature addressing the organizational structure of graduate school dissertation introductions in highly technical mathematics programs, as revealed by an online literature survey.

Keywords: *Swales' CARS, Organizational Structure, Rhetorical Moves, Textual Analysis, Technical Discipline*

INTRODUCTION

Establishing scholarships in research writing requires strong cohesive arguments. Ahmad, Mahmood, and Siddique (2019) claim that writing requires a suitable and strategic use of language with communicative potential and structural correctness. Responding to the preceding arguments might not receive positive feedback from those who would plan to undergo research writing because enhancing writing skills to institute cohesive arguments as requisite for scholarly academic engagement cannot be obtained overnight. In this vein, Quitoras and Abuso (2021) assert that not all faculty in HEIs are engaged in doing research. For them, it is perhaps that most of them do not want to get out from their comfort zone which is teaching or the reason could be that research culture in universities still remains at its infancy. When CMO No. 15, s. of 2019 has been implemented requiring graduate students



to have publication in internationally/nationally indexed journals or juried creative works before granting their respective degrees, a good number of them if not all were caught unprepared since some schools in the country have yet to embrace the said academic requisite. Faculty members teaching in the graduate schools are not an exception because they are also required to publish in indexed journals. Leaning on the bright side, there have been practices undertaken before the said implementation that could probably ease the present growing concern and one of them is transforming thesis and dissertation studies into journal article publication. In fact, both public and private organizations through institutional initiatives have been conducting seminar-workshop relative to it to nurture research culture in the academe.

Viewed from the foregoing, writing an effective research introduction to attract readers' attention is a crucial part of neophyte and even seasoned researchers to effectively address the challenge of transforming thesis and dissertation studies into journal publications. This huge interest in studying research article introductions in many academic writing analyses stems from the fact that research article introductions serve as an important part that presents a logical explanation of the research and persuades readers to read the article thoroughly as they point out the analysis and significance provided by the current research toward the advancement of human knowledge (Swales & Peak, 2012; Kendal, 2015 cited in Rochma, Triastuti, & Ashadi, 2020). Hence, the establishment of a scholarship draws reader's attention and respect. However, writing research introductions has always been a grueling task, particularly for neophyte researchers. This is because laying the foundation of a solid scholarship requires organizational patterns that help find relevance to the current research conversation when contribution to the fund of knowledge is its foundation.

Based on the above, it can be said that reading, analyzing, and organizing texts from voluminous literature to identify, first and foremost, the research gaps take so much time, and there are other rhetorical structures that need to be put into shape to strengthen the paper's cohesive argument. Writing theses and dissertations as well as writing articles for journal publications requires a forceful argument to prove the study's worth as a product of scholarship. Paltridge and Starfield (2020) contended that claiming centrality or significance of the research in question emanates from the research introduction, outlining the overall argument of the theses slowly begins. Additionally, the Introduction section obtains the gateway to a crucial argument, as it exhibits the essential reasons why the study is conducted. In this scenario, a dissertation introduction strengthens its merits when it follows rhetorical structures that need to be carefully designed to persuade the community of readers. Swales and Peak (2012) argue that to produce reader-friendly introductions, writers have to engage in an effective organizational pattern called a rhetorical structure. To understand the design of this rhetorical structure of the introduction, the Create-A-Research-Space (CARS) model serves as the framework of the present analysis. For over three decades, this model has been used by researchers as their primary analytical instrument when the subject of research analysis focuses on the introduction section of research articles, or in the RA's other parts when it can be appropriately utilized.

In retrospect, the CARS model came into existence as a principled outcome of John Swales's analysis of several journal articles representing various discipline-based writing practices.



The theory-driven result suggests that writers follow a general organizational pattern in response to two types of writing demands: (1) the need to create a rhetorical space and (2) the need to attract readers to that space. As proposed by the model, three actions prevail wherein Swales calls them “moves” and in each move details the specific steps that mirror the development of an effective introduction for a research paper. A move is understood to be a practical part of texts to achieve a communicative purpose or to seek the attainment of a defined goal (Brett, 1994; Hopkins & Dudley-Evans, 1988; Martin & Martin, 2003, & Swales, 1990, 2004 as cited in Kheryadi & Suseno, 2021). Despite the differences in describing the “moves” and “steps” (e.g., Bhatia, 1993; Kanoksilapatham, 2005; Nwogu, 1997, Yang & Allison, 2003), many tend to conceptualize a ‘move’ as a distinctive communicative act to achieve a communicative purpose through a segment of text, while a ‘step’ usually acts as a component of a ‘move’ that provides more detailed linguistic means of realizing the rhetorical function of a ‘move’ (Denda & Wannaruk, 2021). Swales and Feak (2012) assert that, although a move may vary in length from a single sentence to several paragraphs, it generally contains one central theme of achieving one main communicative objective.

The current investigation relies on genre theory as its foundation. This principle has been fueled by the seminal works of Swales (1990, 2004), Martin (1992), Miller (1992), Yates and Orlikowski (1992), Bhatia (1993), Bazerman (1994), and Eggins (1994). Their pioneering research has strengthened the development of genre theory, serving as a significant framework in the analysis of non-literary genres such as research articles (RAs). In consonance with this, Swales (1990) surmises that the genre concept has since been treated to indicate a “distinctive category of discourse of any type, spoken or written, with or without literary aspirations as it was first introduced in the 1980s.” According to Swales (1990), a genre is a class of communicative events that are recognized and employed by specific discourse communities with shared communicative purposes. Speaking of communication within specific discourse communities, Bhatia (2017) claims that communication is not simply a matter of putting words together in a grammatically correct and rhetorically coherent textual form; more importantly, it is also a matter of having a desired impact on the members of a specific discourse community and of recognizing conventions they follow in their everyday negotiation and dissemination of meaning in professional contexts. In this sense, communication is more than simply words, syntax, and even semantics. In fact, he states that it is a matter of understanding ‘why and how members of specific professional or disciplinary communities communicate the way they do. On elevating the works of Swales (1990) and beyond, Hyland (2015) explains that Swales has encouraged people to see genres in terms of the communities in which they are used, and to understand texts as a function of the choices and constraints acting on text producers. He adds that Swales has also shown to people that genres are not merely collections of similar texts, but schema researchers develop through their shared experiences to see how these texts help construct particular contexts. Essentially, semantic-driven genres are categories of texts realized by conventionalized moves/steps and linguistic expressions to accomplish the social actions of particular discourse communities. Thus, the application of the model that came out from it has allowed the researchers to do a systematic investigation of the structural and rhetorical features of new or unfamiliar genres or to offer insights into already familiar ones. In Swales (1990, 2004) CARS (Creating a Research Space) model to analyze academic texts, a text itself is considered formed by various units (‘moves’) and sub-units (‘steps’) that are



considered as “discoursal or rhetorical units by definition performing a coherent communicative function in a written or spoken discourse” (Swales, 2004).

In other words, moves and steps are now regarded as the sections and sub-sections that constitute the rhetorical structure of a text, executing a specific communicative function within the same text that enables researchers to systematically investigate the structural and rhetorical features of new or unfamiliar genres or offer insights into already familiar ones. In Swales’s (1990, 2004) CARS (Creating a Research Space) model to analyze academic texts, a text is considered formed by various units (‘moves’) and sub-units (‘steps’), which are defined as “discoursal or rhetorical units that perform a coherent communicative function in a written or spoken discourse” (Swales, 2004). Thus, moves and steps are regarded as sections and sub-sections that constitute the rhetorical structure of a text, performing a specific communicative function within the same text. The model has been applied to the investigation of academic discourse to the extent that Swales himself has produced a revised CARS model that suits most academic genres, such as introductions to research articles and abstracts (Swales, 2004). Treated as a highly technical discipline that employs applications and theoretical foundations in the areas of statistics, geometry, calculus, physics, etc., it is worth studying whether mathematics follows rhetorical patterns. It is for this reason that the present inquiry was conducted because literature on the research analysis of the organizational structure of graduate school dissertation introductions, as seen from a highly technical mathematics program, is scarce based on an online literature survey. Using Swales’ CARS model as a framework of analysis, the present inquiry then tries to determine if the graduate school dissertation introductions of the program, Doctor of Philosophy in Mathematics of a state university journal publication-ready through a content analysis of their organizational structure using Swales’ CARS model. Therefore, the results of this study provide data-driven information that serves as proof that writing scholarly research introductions demands specific moves and steps that fuel the usual introduction-body-conclusion canonical part.

METHOD

The present study used a mixed method. However, the quantitative method of treating the data focused only on a simple frequency count of data occurrences and a fish bowl draw. Textual analysis was used as a qualitative method of data analysis that was utilized extensively in order to examine and describe the communicative intent of the data extracted from the selected dissertation introductions of PhDs in mathematics. Specifically, content analysis was used to identify, enumerate, and analyze the communicative purposes of the occurrences of moves and steps, paying much attention to the inferences that characterize the message-driven meanings in the identified data. To establish consistency and validity of the data that were initially coded, intercoder reliability was employed, in which the goal is to let researchers agree to the same data set being coded – the organizational structures employed in the dissertation introductions. O’Connor and Joffe (2020) claimed that substantiating the credibility of the coding process requires a test of intercoder reliability (ICR) because it provides confidence that specific efforts were made to ensure that the final analytic framework represents a credible account of the data. Only one dissertation represents each



year to identify the data for analysis. A fish bowl draw was used when a particular year had more than two to three graduates producing dissertation manuscripts. Procedures to collect the significant data within the dissertation introductions centered on (1) obtaining copies of dissertation introductions of PhD Mathematics at the NORSU graduate school ranging from the years 2019 to 2023-a span of five years, (2) highlighting the clauses in the dissertation introductions that contain the possible moves and steps based from Swales' CARS Model serving as the basis of the unit of analysis, (3) putting the clauses as research data into the table, (4) coding each data as 'D' for dissertation with its corresponding year it was book-bind and submitted to the Office of the Graduate School, and (5) analyzing, interpreting, and discussing the clauses as seen in particular parts of the dissertation introductions based on move and step analysis in order to find out the researchers' cohesive arguments reflecting the scholarships in the organizational structures of the graduate school dissertation introductions as seen from a highly technical discipline.

The CARS model developed by Swales, as shown on the next page, served as the framework for analysis.

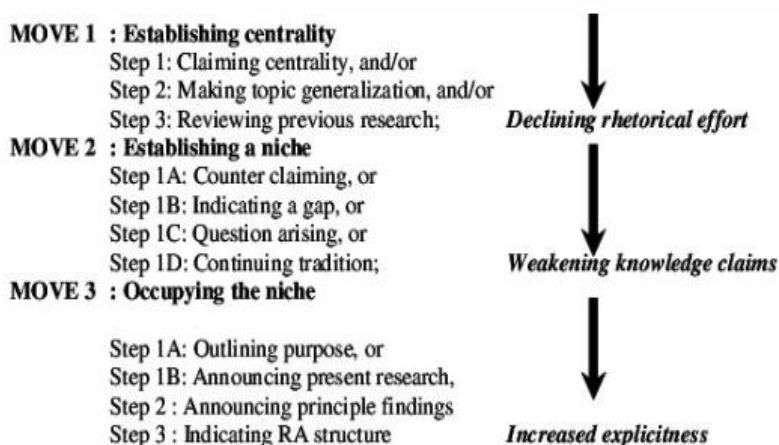


Figure 1. *CARS model*

RESULTS

Provided below are the results of the current research investigation.

Table 1. *Frequency Occurrence Distribution of CARS Moves and Steps in the Dissertation Introductions*

	D'23	D'22	D'21	D'20	D'19	Total
Move 1 = Establishing a territory						
Step 1: Claiming centrality	0	2	0	0	1	3
Step 2: Making topic generalization	1	2	2	3	4	12
Step 3: Reviewing items of previous research	8	7	5	6	7	33



Move 2 = Establishing a niche

Step 1A: Counter-claiming	0	0	0	0	0	0
Step 1B: Indicating a gap	2	0	0	0	0	2
Step 1C: Question-raising	0	0	0	1	0	1
Step 1D: Continuing a tradition	0	0	0	0	0	0

Move 3 = Occupying the niche

Step 1A: Outlining purposes	1	1	1	0	1	4
Step 1B: Announcing present research	0	1	3	3	0	7
Step 2: Announcing principal findings	0	3	0	0	0	3
Step 3: Indicating research article structure	0	0	0	0	0	0

Table 1 shows the frequency occurrences of CARS moves and steps, as analyzed in the dissertation introductions, serving as data for analysis. As can be seen, under Move 1 (establishing a territory), Step 3 obtains a higher frequency of regularity, obtaining a total of 33 occurrences. This is followed by Step 2 (making topic generalizations), obtaining 12 occurrences. Step 1 (Claiming centrality) obtains only three occurrences. With regard to move 2 (establishing a niche), it can be observed that there is a dearth of rhetorical arguments, as realized through the different steps. Step 1A (counterclaiming) becomes zero, whereas Step 1 B (indicating a gap) has only two occurrences. Step 1C (question-raising) obtains only one occurrence and Step1D (continuing a tradition) obtains nothing at all. In Move 3 (occupying the niche), Step 1 B (announcing the present research) secures seven occurrences, as identified in the clauses using Swales' CARS model. This is followed by Step 1A (outlining purposes) with four occurrences and three occurrences for Step 2 (announcing principal findings), whereas Step 3 (indicating research article structure) earns zero occurrence.

Move and Step Clause Data Presentation

Move 1 (Claiming a territory)

Step 1: Claiming centrality	<p><i>"This study has important applications in some areas of mathematics."</i> (D'22)</p> <p><i>"We extended the concept irregularity strength of graphs to a more general concept in the direction of edge irregular labeling..."</i> (D'19)</p>
Step 2: Making topic generalization	<p><i>"Graph theory has many applications in various fields after resurgence of interest in 1920."</i> (D'23)</p> <p><i>"Topology is a new subject in mathematics, being born in the 19th century."</i> (D'22)</p> <p><i>"A non-empty set U with a binary operation $*$ is an Ubat-space if..."</i> (D'21)</p> <p><i>"The Machiavellianism is being described as the use of the general principle-the end does not justify the means."</i> (D'20)</p>



"This parameter of a graph G is well-known as the irregularity strength of a graph." (D'19)

Step 3: Reviewing items of previous research

A study on the spectra of central graphs of a connected regular graph was conducted by Jahfar and Chithra (2020)." (D'23)

"Mashhour et al. [21] presented pre-open sets." (D'22)

"The term group was introduced by Galois to refer to a collection of permutations that is closed under composition of functions." (D'21)

"Machiavelli introduced the used of pragmatic instructions to a new prince on ... (Machiavelli, 1988)" (D'20)

"Motivated by these studies, Baca et al. in [18] introduced vertex irregular total k -labeling of graph." (D'19)

Move 2 (Establishing a niche)

Step 1B: Indicating a gap

"The studies mentioned above on the operations of graphs only focused on finding the spectrum, Laplacian spectrum, and sign less Laplacian spectrum." (D'23)

"This study introduces a new graph operation based on central graphs, called bicentric edge joins of graphs." (D'23)

Step 1C: Question-raising

"After more than 400 years of Machiavelli work, a question is now raised, whether the philosophical principle introduced can possibly be translated into mathematical principle." (D'20)

Move 3 (Occupying the niche)

Step 1A: Outlining purposes

"This study aims to define... provide..." (D'23)

"This study aims to introduce the concept Ubat-space and give some of its important properties." (D'21)

"In this study, we will determine the r -irregularity strength of the following classes of graphs..." (D'19)

Step 1B: Announcing present research

"This study focused on one – the σ -open sets." (D'22)

"Specifically, it can be used to minimize digital circuits." (D'21)

"This paper establishes the logical connective used for the variant of logic called justification." (D'20)

Step 2: Announcing principal findings

"The results of this study will give complete understanding of the concept..." (D'22)



“In the future, this study may also serve as a link between the present information on the notions...” (D’22)

“Moreover, the results generated in this study are important as they may lead to further related studies and trigger more substantial results on this topic.” (D’22)

Table 2. *Dissertation Introduction Move Structure*

	Move(s) followed
D’23	1 3
D’22	1 3 1 3
D’21	1 2 1 3
D’20	1 2 3 1 3
D’19	1 3

On the need to transform dissertations (such as PhD in Mathematics program) to journal article ready-publication with smoothness and ease, the data found in Table 2 above say it otherwise. It can be seen that the writing of dissertation introductions as depicted by the moves being followed shows restricted research direction using Swales’ CARS model. Adding to its unfavorable attempts is the presence of limited clauses/sentences, signifying research gaps that must be addressed to enrich new knowledge sharing. Although literature reviews (in Move 1) are actively utilized, their utilization (as analyzed textually) is limited to an enumeration of cited sources. Comprehensive arguments of their similarities, differences, and ways to fill the current research conversations against the subjects of the current dissertations are not exhaustively done to merit the scholarly conversation needed for potential journal publication. Therefore, an attempt to transform these dissertations to be indexed in refereed journals needs more literature reviews, as argued scholarly, to include the voices of the researchers in the present investigation in order to fortify scholarships.

DISCUSSION

Given below are the pieces of discussion of the present investigation.

Move 1 (Establishing a territory)

This part of the research move that is specific to Step 3 (Reviewing items of previous research) getting huge frequency occurrences is proof that in research undertaking, a scholarly review of pieces of literature related to the present inquiry is a mandatory requirement that cannot be ignored, especially in writing the research introduction. Boaz and Sidford (n.d.) contended that reviews are required to determine what is already known, to bring together results from different studies, and to provide a starting point for new research. In other words, what makes Step 3 mandatory to initiate in any form of research inquiry, not just in writing theses and dissertations, is the fact that it opens opportunities for researchers to distinguish the plethora of research studies in the field, and from it, they could argue that the similarities and differences serve as supports to the present study. When gray areas are



identified in these reviews, researchers would now be given a chance to conceptualize the direction in which their study would advance. However, Step 3 must be carefully performed to ensure that the evidence communicates soundly to diverse audiences taken from legitimate sources. Likewise, Step 2 (making topic generalization) with a good number of occurrences is within the radar of writers writing dissertation introductions. In the field of mathematics, this tells us that making topic generalizations is very lifeblood. Mason (1988 in Suwanto & Wijaya, 2018) argues that mathematical generalization has to do with noticing patterns and properties common to several situations. Further, mathematical generalization is not only the basic and characteristic way of thinking and reasoning to indicate the process by which concepts are seen in a wider context but also the product of the process (Haylock & Thangata, 2007; Tall, 2002 as cited in Suwanto & Wijaya, 2018). With this, it is no surprise to see that the field of mathematics is in the business of establishing current knowledge, consensus, practice, or existing phenomena, such as on the topics of graph theory, topology, etc., in order to advance scholarship in the field. Regarding Step 1(Claiming Centrality), this part of Move 1 is not well utilized in the writing of dissertation introductions. Claiming centrality in the form of topic sentence(s), especially written at the beginning of the introduction, is too significant, as it serves as the research argument in which it would become the guide in the construction of the narrative of the research paper. Attached to its significance are thorough reading and reflection. This is the reason why evidences/statements follow it, supporting the notion that the current research is both useful and important. Analyzing the practices in writing the dissertation introductions, it is observed that the writers have been dwelling on existing literature presentations at the beginning of the dissertation. If this continues, establishing the worth of investigating the study could not clearly define new insights, as the absence of research arguments is not nurtured well. Although in some journal publications, quoted literature from previous researchers has been used to present arguments at the beginning sentences of the introduction, statements that follow them clearly indicate counter-claims or the basis of gaps/limitations discovered by current researchers whose singular aim is to address them in order to secure a space in the research conversation. The same evidence cannot be found in the context of the present inquiry.

Move 2 (Establishing a niche)

The different steps to establish research gaps under Move 2 provide research writers with sufficient ideas on how to deal with gap filling. As shown in Table 2, however, occurrences of clauses to represent the various steps under Move 2 are found to be deficient. Although Step 1 B (indicating a gap) and Step 1C (question-raising) have two occurrences for the former and one occurrence for the latter, they are not enough to conclude that writing the dissertation introductions is based on finding new insights. In the discipline of research writing, such as journal publication as well as thesis and dissertation writing, identifying research gaps is of top priority because researchers cannot contribute to the funding of new knowledge if they are not well established. In journal publications, outright rejection is received if there is no solid evidence that the submitted research article addresses the research gap. Supporting this argument, Abass, Banjo, and Abosede (2020) postulate that researchers must indicate that a gap exists in knowledge concerning the phenomenon of interest, as every study is expected to contribute to knowledge and literature. Robinson et al. (2011 as cited in Müller-Bloch & Kranz, 2015), they posit that a research gap holds an important function as a starting



point for research. While they emphasize that research gaps represent an output (of literature review), Müller-Bloch and Kranz (2015) adduct that they perceive them as an input that can motivate further research.

Based on the preceding statements, Move 2 requires every author/researcher to establish an argument that there exists an open “niche” or grey area in the current literature that has to be filled out through the provision of additional research. For Suryani, Yacob, and Abd Aziz (2015), the research gap necessitates the writer to give an account of the research area and point out the research space that exists in the body of the research. For them, the writer seeks to convince the audience that the research space requires further investigation and is worth studying. However, the data under analysis, as shown in Table 2, provide no satisfactory utilization. Perhaps Step 1A (counter-claiming) obtains zero occurrence at all because the authors or researchers in writing the dissertation introductions have the burden of presenting solid evidence if they want to refute or challenge earlier or existing research by making a counter-claim. This is true even for the other Steps under Move 2. If there were attempts to use any of the steps, arguments aiming to prove respective spaces in research conversations would only utilize neutral statements in order not to devalue other researchers’ well-founded phenomena directly.

Move 3 (Occupying the niche)

Relative to Move 3 (Occupying the niche), authors/researchers need to demonstrate ways to substantiate the counter-claim made, fill the gap identified, answer the question(s) asked, or continue the research tradition. This section clearly announces the present inquiry’s contribution to the creation of new knowledge or conceptualization of a new perspective in comparison to prior knowledge with regard to the topic on hand. As analyzed, Step 1 B (Announcing present research) obtains more occurrences than the other Steps under this Move.

In writing research papers, authors/researchers understand that for them to get their ideas across their intended audiences successfully, they have to describe shortly but succinctly what the research is trying to achieve. Concise as it is, this too requires a thorough review of significant literature because it attempts to data-mine gaps in knowledge that have to be filled out. It is through this that suitable research objectives can be framed meaningfully. Thomas and Hodges (2010) affirmed that in the design of a research project, one has to give himself/herself plenty of time to think through the aims and objectives. They added that this thinking should not be done in a hurry because a researcher has to read around the subject, analyze previous studies in the area, and look at how other researchers frame their aims and objectives. This is to say then that building research scholarships need to enrich one’s cognitive structure and schema through literature survey which requires more time to reflect in the process. Step 1A (Outlining purposes): Four occurrences seem to have a thin line of difference with Step 1 B (Announcing present research), as it also tries to answer in clear language the research’s aims and objectives. When confronted with these two in research writing, the author/researcher can choose either of them. This might be the reason why PhD Mathematics students writing their dissertations had utilized Step 1 B (Outlining purposes) because this is an obligatory part that has to be satisfied in writing the dissertation



introductions. Similar to Step 1 B (outlining purposes), Step 2 (announcing principal findings) also has a share of its occurrences (3), as it could be said that it is also an obligatory part that would be asked how the dissertation introductions are being framed. Step 3 (Indicating research article structure) receives no occurrence at all because this serves only as an addition or remainder to how a research paper, like the dissertation introductions, is constructed. In general, the different Steps under Move 3 could be said to have not been fully utilized in the writing of dissertation introductions because of their limited representation in the research data.

Conclusion

Although the writing of the dissertation introductions of the program, Doctor of Philosophy in Mathematics as a technical discipline, has leaned toward satisfying Swales' CARS move and step patterns in the organization of their structures, it is not enough to consider them journal publication-ready as analyzed textually. Strong cohesive arguments, especially the identification of research gaps and the employment of other CARS moves and steps with solid support evidence extracted from scholarly literature review, must be established, as they are important requisites if research articles drawn out from graduate school dissertations are submitted for potential consideration to any legitimate refereed-indexed journals. Thus, emphasizing the utilization of the writing principles of Swales' CARS model in writing theses and dissertation introductions creates opportunities for graduate students to produce research works that would not only be used to earn their respective degrees but also for them to foray into refereed journal publications with renewed confidence and scholarship. When this becomes the norm, knowledge creation through scholarly research and discovery continues to advance, instigating sustainability and innovation that surely benefit human existence in all walks of life.

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