Balancing Students' Cognitive Load in Instructional Design to Ignite Academic Achievement in the Fire Academy: An Exploratory Case Study

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ABSTRACT

Instructional design in a fire academy is crucial for achieving high academic standards. The current study examined the cognitive load of fire academy students. A qualitative exploration used the cognitive load framework, employing a site-based approach to investigate how intrinsic, extraneous, and germane loads reflect the learning experience. This exploratory case study engaged four female and six male students and five male instructors from the Midwestern Urban Community College's Fire Academy. Semi-structured interviews and classroom observations provided a pathway to gaining insight into participants' perceptions of learning in a classroom. This exploration found that, with three courses in a 16-week semester, low student preparedness for learning and low academic achievement were challenging in a lecture-based classroom. The implications are the urgency of redesigning the instructional approach. Based on the results, the fire academy should adopt a blended classroom approach, with more time to study and prepare for learning in both theory and practice.

Keywords: blended learning, student collaboration, cognitive load, learning experiences, teamwork, case studies, mentoring, simulator learning

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Fire academies across the country provide firefighter training that enables students to become active, certified firefighters for employment (Bureau of Labor Statistics, U.S. Department of Labor, 2021; Henderson et al., 2007; Ripley & Ripley, 1994; Wright & O'Driscoll, 2009). Quality instructional practices in an engaging learning environment enhance student learning and performance in the fire academy, guide effective learning outcomes, and help eliminate the challenges students face in the classroom. Removing or minimizing these challenges provides the academy with an instructional approach that supports higher-quality student performance. There is a need to address low academic performance and recognize instructional difficulties in practice that minimize student learning. This can be achieved by collaborating with students, instructors, and other faculty (Burns, 2017; Myers et al., 2008; Silberstang & London, 2009; Smart, 2014). As training and credentialing become more rigorous, instructors need to teach students using the most appropriate instructional methods.

Midwestern Urban Community College and other fire academies across Kansas face issues of low academic performance in the classroom (Coffeyville Community College, 2019; Cowley College. 2019; Dodge City Community College, 2019; Kansas Fire and Rescue Training Institute, 2021; Midwestern Urban Community College, 2019; Northwest Kansas Technical College, 2019). Research indicates that the implementation of blended and flipped classrooms, including lectures with critical thinking activities involving active (hands-on skills) and experiential learning, benefits student learning (Bostrom & Palm, 2020; Kolb, 1975, 1999; Schmidtke, 2017; Shanbhag et al., 2020; Silberman, 2009; Swanson & Holton, 2022; Walker,

2019). Limiting classroom instruction to lectures without incorporating active or experiential learning with critical thinking skills applied through models or frameworks lessens the effectiveness of learning experiences and the motivation to learn (Atkinson, 1964; Bostrom & Palm, 2020; Cha et al., 2012; Eccles & Wigfield, 2002; Schmidtke, 2017; Wigfield & Eccles, 2000; Wigfield et al., 2004). Midwestern Urban Community College (2019) can no longer ignore best practices in student instruction.

This study focuses on the challenges faced by students at Midwestern Urban Community College. The students and instructors struggle to deliver and learn the course content in one semester. This exploratory case study explicitly examines the students' cognitive load within the fire academy's curriculum, instruction, and classroom design (Larmuseau et al., 2019; Likourezos, 2021; Parte et al., 2018; Sepp et al., 2019; Sweller, 1988; Sweller, 2020).

Statement of the Problem

National trends show that all fire departments seek to hire students with Hazardous Materials Awareness and Operations (HMAO), Firefighter 1 (FF1), and Firefighter 2 (FF2) credentials (International Fire Service Accreditation Congress, 2020). Currently, the Fire Academy at a Midwestern Urban Community College faces a problem of low academic performance in the classroom. Fire academy students need to master their coursework to become eligible for employment. Students learn to identify potential hazards associated with hazardous materials from transportation and stationary placards and to assist hazardous materials technicians when required. Two additional courses, Firefighter 1 and Firefighter 2, provide students with the basic and advanced theories and hands-on skills for state certifications (Dunn et al., 2019; International Fire Service Accreditation Congress, 2020; Kansas Fire and Rescue

Training Institute, 2021). However, the fire academy at the Midwestern Urban Community College faces a problem of low academic performance within these courses.

In the past three years, final exam scores at the Midwestern Urban Community College have not demonstrated the level of learning necessary for students to become certified firefighters and active members of a career fire department. Before 2019, students' average final-exam failure rate was 5% for HMAO, 12% for FF1, and 6% for FF2 (Dunn et al., 2015; Midwestern Urban Community College, 2015). The current students' average final-exam failure rates are 32% for HMAO, 57% for FF1, and 43% for FF2 (Dunn et al., 2019; Midwestern Urban Community College, 2019). These exam score results highlight the need to investigate the factors contributing to low academic performance.

Students in this Midwestern Urban Community College's Fire Academy need to receive a 70% or higher score on the fire academy's final exam to participate in required state certification exams (Dunn et al., 2019). Over the last three years, the average final exam scores per semester from both fire academies at this Midwestern Urban Community College were 68% for HMAO, 67% for FF1, and 69% for FF2 (Dunn et al., 2019; Midwestern Urban Community College, 2019). Given these alarming statistics, it is necessary to examine fire academy instructional practices and the cognitive loads affecting student performance.

The information gained from the literature review serves as a starting point for exploring classroom instructional methods and balancing the cognitive load involved in understanding how instructors and students connect theory and application with real-life scenarios and beyond (Mayer, 2018; Mayer, 2003). This issue affects funding and other resources and, if not addressed, could lead to instructor layoffs, funding cuts, and ultimately the elimination of the program.

These impacts may also affect other technical education programs within the college, delivered in the same format, without further research.

Currently, the classroom portion of the academy is lecture-based, with a question-and-answer session, but no activities to assess student learning. Students struggle with low academic scores on written exams, whether in multiple-choice questions or essay format. Students attending the fire academy have diverse skill sets and represent various demographics (Meeuwisse et al., 2010). Student backgrounds and prior educational experiences may affect their ability to maintain an appropriate level of cognitive load while learning (Sweller, 1988). Regardless of campus location, MUCC seeks to provide an equitable, high-quality learning experience that leads to positive student performance outcomes.

Without a critical examination of the Fire Academy's teaching and learning strategies, the program continues to underperform academically. Addressing this issue improves student performance, informs the college's decisions about the program's continuation, and assesses the resources needed to change instructional practices (Morrison et al., 2019). This Midwestern Urban Community College Fire Academy must review its current practices and identify necessary changes to improve student performance. If students cannot pass in-house exams with a score of 70% or higher during the semester, they will not be able to participate in state certification exams at the end of the semester (Dunn et al., 2019). Firefighting is a rigorous career that requires strength and good health. However, having the knowledge and experience to apply that strength with good health is equally important for promising recruits to sustain their performance.

Literature Review

This literature review addresses the problem of low academic performance among students. It examines the roles of instructional best practices, teaching models in the fire academy, and improving instruction for students wanting to become firefighters. Through a holistic lens of firefighting instruction, blended approaches that combine online and face-to-face learning, or a flipped classroom environment, engage students in learning and performance. These practices have gained popularity with research supporting their use. (Akcayır & Akcayır, 2018; Goedhart et al., 2019; Kintu et al., 2017; Özdamli & Asiksoy, 2016; Zhu et al., 2021). Educational organizations in the United States utilize these instructional methods to prepare students for their future professional fields.

Experiential learning combined with collaborative learning engages students through past experiences, hands-on skills, and student discussions. Instructional models in the fire academy using experiential, active, or collaborative learning provide structure to balance the students' cognitive load (Bell & Bell, 2018; Laal & Ghodsi, 2012; Meeuwisse et al., 2010; Simic, 2012; Summers et al., 2005; Sweller, 1988; Sweller, 2020; Tissenbaum & Slotta, 2019; Vasquez, 2018; Walker, 2019). However, the fire academy currently focuses solely on lecture-based instruction, with no student activities beyond hands-on skill training and case studies.

Case studies and live-fire training evolutions are equipping students at the fire academy with the most up-to-date firefighting knowledge. Students actively use case studies to reflect on past experiences. While sourcing case studies, students compare them. Once students understand the case study, they begin to analyze and question why it unfolded the way it did. Analyzing the case study instills critical thinking skills and inspires students to ask difficult questions

(Chakraborty et al., 2010; Duran & Dokme, 2016; Flynn & Klein, 2001; Huang et al., 2020; Liu, 2009; Thistlethwaite et al., 2012).

Live-fire training evolutions are controlled, real-life exercises for students at the end of the fire academy. Students begin the academy with minor changes and work on adding more hands-on skills to integrate them into several significant developments. This training is currently the capstone to becoming a firefighter recruit, preparing them for the next chapter in their lives (Bell & Bell, 2018; Chan et al., 2017; Knight & Brame, 2018; Perez, 2019; Walker, 2019). These evolutions put firefighting in perspective and enhance learning once hired into a fire department.

This exploratory case study addresses a gap in the research literature by introducing new learning methods and practices to improve firefighter training and enhance student performance. While lecturing is the primary instructional method currently used in higher education today (Bell & Bell, 2018; Boyer et al., 2019; Fender, 2018; Gurpinar et al., 2010; Meeuwisse et al., 2010), this type of learning may be holding the fire academy back from experiencing better outcomes in student performance. Previous research (Burnham & Makienko, 2018; Davis et al., 2020) shows that instructor-based learning incorporates student activities into the curriculum. However, student-led instruction could be a better alternative for firefighter instruction and training. The hands-on skills learned in the fire academy are individual skills and team skills, but there is no collaborative learning before teaching these skills in the classroom (Akcayir & Akcayir, 2018; Goedhart et al., 2019; Kintu et al., 2017; Marvell et al., 2013; Ozdamil & Asiksoy, 2016; Smith, 2017; Zhu et al., 2021). Adding more collaborative learning in the classroom could help students connect their experiential and active learning activities. Exploring experiential, active, and collaborative learning from a classroom perspective could benefit

faculty, lab instructors, and peer mentors by focusing on real-world experiences to reduce students' cognitive load.

Faculty and peer mentoring are gaining strength as apprentices in many vocational and technical programs. Mentoring is a type of apprenticeship that focuses directly on the student and assists students' learning from program faculty to learning from peers (Beltman & Schaeben, 2012; Beres & Dixion, 2016; Chao, 1997; Collier, 2017; Dawson, 2014; DeAngelo et al., 2016; Docherty et al., 2018; Gok, 2015; Knight & Brame, 2018; Lahiri et al., 2021; Tsai & Helsel, 2016; Yildiz & Gunduz). This form of learning fosters learning experiences, relationships, and a growth mindset that lasts forever with both the mentor and the mentee. Mentoring can even assist with the use of training simulators and virtual reality experiences.

Training simulators and virtual reality training enhance students' learning by providing meaningful scenarios they may encounter in their communities. As more training simulators are found in fire academies and the fire service, providing students with a first look into future possibilities with training props could change how students learn (Heldal & Wijkmark, 2017; Johannsson et al., 2009; Nestel et al., 2016; Simic, 2012; Summers et al., 2005). This type of training is very cost-effective for scheduling multiple instructors and resources, is more realistic for students, promotes collaborative learning, and fosters working relationships among individuals from different disciplines. While using training simulators with props, students are only provided with a two-dimensional learning platform. Virtual reality learning is the next training model that puts students in the driver's seat to respond, just as firefighters do when they are already on the emergency scene.

Virtual reality is a medium that can provide students with the most realistic experience outside controlled live-fire training. Students can navigate the interior of residential structures or

commercial buildings and replicate a real fire without experiencing the harmful effects of fighting real fires (Bliss et al., 1997; Williams-Bell et al., 2015). This type of training can be more practical, time-saving, and realistic. However, having a dedicated space with virtual reality components can be expensive unless this training is made available to other emergency services or vocational and technical programs.

This literature review includes concepts with commentary from scholars who demonstrate high academic performance. It covers best practices in instructor-led to student-led instruction, blended and flipped classrooms, and the integration of collaborative learning with experiential and active learning. The current teaching models in the fire academy use experiential learning with hands-on skills and active learning with case studies. This literature review also discusses ways to improve instruction for students interested in becoming firefighter recruits. Possible improvements include adding faculty and peer mentors, a training simulator with props, and virtual reality. The development of this literature review involves the cognitive load theory developed by Sweller (1988) and used in other research studies (Bostrom & Palm, 2020; Douglass & Morris, 2014; Larmuseau et al., 2019; Likourezos, 2021; Sepp et al., 2019; Shanbhag et al., 2020; Sweller, 2020; Zhu et al., 2021). This literature review and research study will fill gaps in classroom instruction, raise students' performance, and prepare them for future firefighting careers.

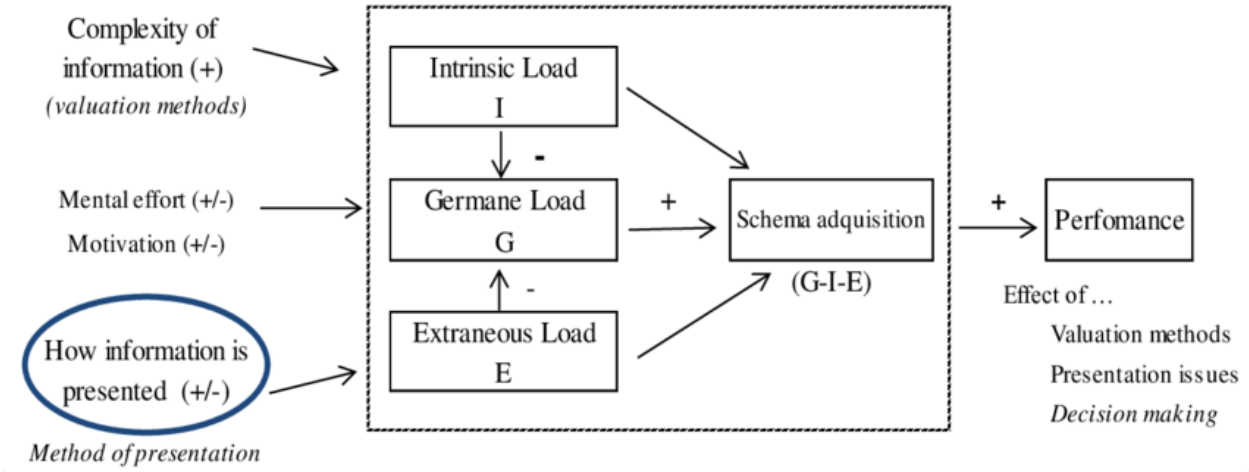
Theoretical Framework

This exploratory case study utilized Sweller's cognitive load theory. This theory entails the core theoretical construct of cognitive load that students effectively use at any point in their education. Students' cognitive load is the amount of working memory resources used to process information before it becomes irrelevant (Sweller, 1988). Cognitive load has three types during

learning new material. First, the intrinsic load is the working load students first encounter when learning. Most students face learning limits because of the complexity of the concepts they can absorb before confusion interferes with learning. Second, the extraneous load relates to how information is presented. Extraneous load can include unnecessary and distracting information. Third, the germane load concerns making connections, linking new information to current information, and developing new schemas to process past learning and experiences (Sweller, 1988). Figure 1 illustrates a basic flow of learning: from the complexity of information (intrinsic load) to the way information is presented (extraneous load), and to the development of new schemas in association with past learning experiences (germane load) (Parte et al., 2018). Balancing the intrinsic, extraneous, and germane loads requires instructors to understand techniques for designing quality curricula with the purpose of promoting student learning (Bostrom & Palm, 2020; Larmuseau et al., 2019; Likourezos, 2021; Shanbhag et al., 2020; Sweller, 2020; Zu et al., 2021).

Table 1

A framework of cognitive load theory



Note. From *Why it's important for international business teaching and financial reporting,* by Parte et al., 2018, *Journal of Teaching in International Business.*

This diagram illustrates how different teaching methods or presentations can affect students' perceptions, assessment, and reasoning as they conceptualize their learning. According to Parte et al. (2018), the method of presentation emphasizes that variations in presentation formats reduce extraneous load and increase germane load. However, if a topic is more complex, more time needs to be dedicated to teaching because the intrinsic load prevents the information from being grasped.

This exploratory case study illuminates practices that facilitate student learning and examines students' ability to balance cognitive load (Sweller, 1988; Sweller, 2020). I used the cognitive load theory (Larmuseau et al., 2019; Likourezos, 2021; Parte et al., 2018; Sweller, 1988; Sweller, 2020; Zu et al., 2021) that directly drives the research questions, data collection,

and data analysis to understand the students' ability to grasp and understand information when participating in the fire academy.

Purpose of the Study

This exploratory case study examined the academic cognitive load of fire academy students in the classroom at this Midwestern Urban Community College Fire Academy. I pursued a deeper understanding of the classroom instructional challenges leading to low academic performance (Burns, 2017; Myers et al., 2008; Silberstang & London, 2009; Smart, 2014). This study explored the role of cognitive load in students' challenges (Sweller, 1988; Sweller, 2020). Analyzing the students' cognitive load and learning outcomes, I provided insight to supplement lectures and instruction (Catena & Carbonneau, 2019; Clark & Plano Clark, 2019; Eccles & Wigfield, 2002; Gormally et al., 2009). The research questions guiding this exploratory case study were:

- RQ1: What are the fire academy students' and instructors' perceptions of intrinsic load in the classroom?
- RQ2: What contributes to fire academy students' extraneous load in the classroom?
- RQ3: What are fire academy students' and instructors' perceptions of the germane load in the classroom?

This exploratory review of students' challenges in the Fire Science Fire Academy at the Midwestern Urban Community College helped stakeholders make necessary changes to improve student learning in the classroom.

Participants

The sampling strategy for this exploratory case study was purposive sampling. The participants include 15 Fire Science Fire Academy students and instructors, as they have the best insight into the phenomenon studied in this research. Using maximum variation (Creswell & Poth, 2016; Yin, 2014; Yin, 2018) broadened the overall depth of the study, which included a sample of 15 participants: five instructors and 10 students. The Fire Science program averages 10 students in each academy. I selected participants of varying ages, educational levels, genders, and ethnicities to maximize variation. With the diversity of the college and the fire academy, a smaller selection of participants from both academies provided a sample of the broader student population and variations in instructors' and students' perceptions. The demographics of students at the two fire academies I selected are primarily White, with a few African American and Hispanic American students, and include both males and females aged 18 to 45. I purposely selected the five instructors who teach in the fire academy and have the most influence on student learning. I also purposely selected 10 students who participated in the fire academy. I reached out to both selected instructors and students, and they agreed to be participants in the study. The rationale for selecting participants for this qualitative study was to expand the focus on student learning through an in-depth analysis that describes the factors contributing to classroom challenges in the fire academy (Lincoln & Guba, 1985; Yin, 2018; Yin, 2014).

Data Collection and Analysis

The data collection protocols in this study entailed student interviews, instructor interviews, and classroom observations. I designed these protocols to elicit thick, rich data while exploring the phenomenon until data saturation (Clark & Plano Clark, 2019; Creswell & Poth, 2016; Yin, 2014). Each interview aligned with my three direct research questions and included

multiple open-ended superlative and situational questions to keep the conversations positive and on track. Table A.1, in Appendix A, describes the alignment of the research questions with the theoretical framework of cognitive load, broken down into three distinct loads: intrinsic, extraneous, and germane. Data analysis included coding interviews and classroom observations. A holistic, bounded approach provided similarities and differences within this case. The data analysis consisted of using the data analysis spiral to prepare, organize, and manage the data, memo new ideas, reduce themes through coding, and further condense the codes. This process also involved developing and assessing interpretations and finally representing the data in figures and tables (Creswell & Poth, 2016). Data analysis also focused on learning activities and experiences that students and instructors believe hinder students within the categories of intrinsic, extraneous, and germane loads. Data analysis was an ongoing process until all possible themes were exhausted. I coded the data using selective coding to categorize it more precisely and identify the themes emerging from the data.

Findings

The findings in this study were derived from interviews with students and instructors and from classroom observations. The interviews helped me understand the participants' perceptions of learning in the classroom, while the observations provided me with a holistic view of their engagement. I collected the interview transcripts via Zoom as the first step in analyzing my data, and I scheduled classroom observations during live lectures. In the following section, I share the findings from each unit of analysis.

Embedded Units of Analysis: Students

The students provided a variety of perceptions of learning in the classroom. First, the fire academy students reported experiencing learning limitations due to the complexity of the coursework. Second, the students shared their thoughts on classroom distractions. Third, the

students explained their classroom experience, and fourth, the students described their personal experience outside the classroom.

Embedded Units of Analysis: Instructors

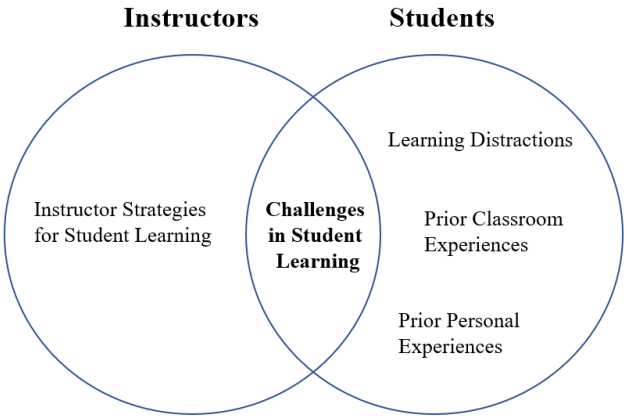
The instructors also provided their perspectives on student learning in the classroom. First, the fire academy instructors expressed that students were unprepared for class. Second, the instructors discussed their perceptions of classroom learning strategies. Every instructor, in one form or another, felt that students need more preparation time for coursework before each class, and having positive learning strategies could improve students' learning.

Emergent Themes

Based on data from participant interviews and observations, one significant theme emerged—the lack of preparation and the sense of overwhelm related to the course content pose challenges to student learning. The students faced challenges learning new topics they had not encountered before in their lives or in other courses. They were overwhelmed by the volume of information and the extensive reading required before each class session. It was also apparent from the instructors' perspective (as shown in Figure 5) that the students were not prepared to learn in the classroom as the instructors expected.

Figure 2.

Significant challenges within classroom learning

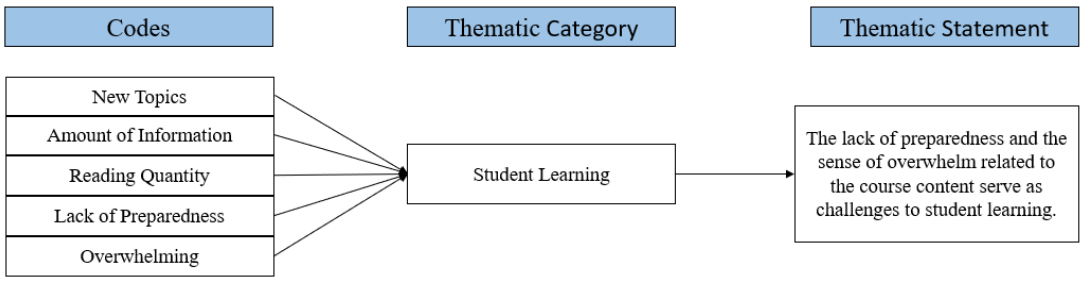


Emergent Themes Specific to Instructors and Students

During classroom observations, each instructor emphasized the importance of the reading assignments for success in the classroom. Second, while the instructors and students shared commonalities in classroom learning, other significant themes emerged that did not necessarily align with one another. The lack of common themes is significant, as this may indicate other reasons why students are struggling to master the content. These other themes were learning distractions, prior classroom experiences, prior personal experiences, and instructor strategies for student learning. Figure 3 demonstrates the codes, thematic category, and thematic statement.

Figure 3.

Coding and emergent themes



Student learning

The lack of preparedness and the sense of being overwhelmed by the content serve as challenges to student learning. A combination of new topics, the volume of information, the amount of reading, preparation for the class session, and the feeling of being overwhelmed hindered student learning. The fire academy introduced a chapter with a new topic each class session, and students needed to be familiar with the lesson topic. However, these new topics were sometimes more than the students could absorb in one class session. While there was a tremendous amount of curriculum to cover in the fire academy, the instructors did not always have time to revisit the course materials with the students.

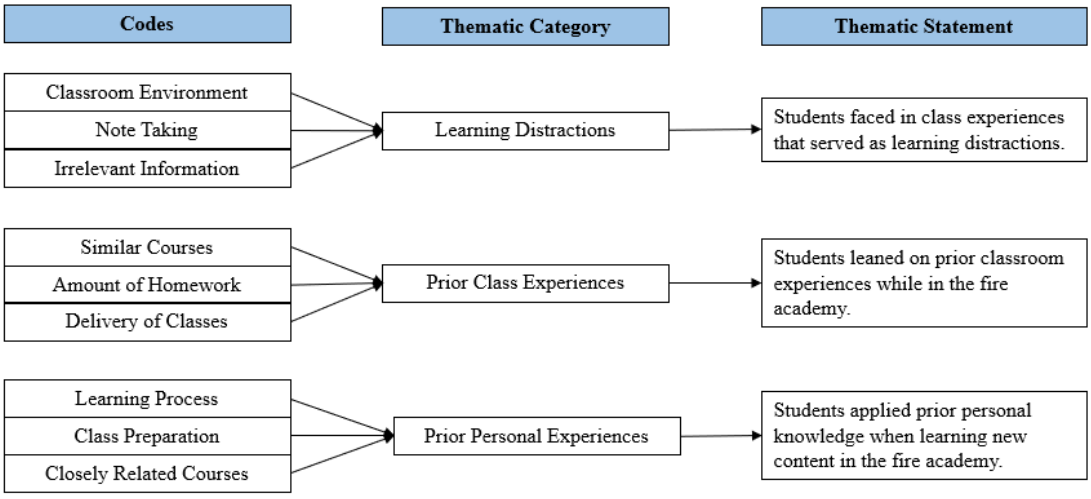
Significant Emergent Themes Specific to Students

Based on the data from student interviews and observations, three significant themes emerged. These themes did not emerge during the interviews with the instructors. However, the themes are significant because the study focuses on improving student experiences, leading to positive learning outcomes. The lack of commonalities between embedded units of analysis indicates that instructors and students have varied experiences. While the instructors described utilizing various learning strategies, the students did not mention them. These themes specific to

the students provide insight into how they are attempting to succeed in the fire academy. The students expressed their perceptions of learning in the fire academy classroom. In addition to student learning, I used distractions, prior class experiences, and prior personal experiences to organize the data. Figure 4 demonstrates the codes, thematic categories, and thematic statements.

Figure 4.

Coding and significant emergent themes



Learning distractions. Students experienced in-class distractions that hindered learning. These learning distractions in the classroom — such as irrelevant information not associated with the course content, writing notes, highlighting in textbooks for study, and the learning environment in the firefighting classroom — complicate learning. Learning distractions interrupted and complicated the students' attempts to focus on the information they received during lectures. These distractions included students talking, instructors' storytelling, and students attempting to take notes in class.

Prior classroom experiences. Students drew on prior classroom experiences during the fire academy. The student learning in the fire academy classroom benefited from past classroom experiences that students

could reflect upon and utilize in class. This theme included instances from students' previous classroom experiences, the amount of reading they did in those classes, and the content delivered.

Prior personal experiences. Students applied prior personal knowledge when learning new content in the fire academy. This theme involved instances of learning new information and using previously developed schemas to support that learning.

Answering the Research Questions

The subcodes and themes that emerged from the data revealed participants' experiences in the fire academy. Each theme offered a response to the research questions. In each research question, I opened myself up to understanding each participant's responses and their perceptions of the fire academy. I also removed myself from applying any personal assumptions and biases to gain an accurate account of their responses.

Research question 1. The first research question was, "What are the fire academy students' and instructors' perceptions of intrinsic load in the class?" The intrinsic load centers on the complexity of the content presented. When students reach the top end of the intrinsic load, they become overwhelmed and lose focus. Based on the findings, students and instructors reported instances of students arriving unprepared for class. This lack of preparedness stemmed from students not reading the assigned textbook chapters. The participants also explained that the volume of information and the new topics embedded in the coursework left students feeling overwhelmed. The participants shared insights into their experiences during lectures as students struggled to keep up with the reading and studying in the textbooks.

Research question 2. The second research question was, "What contributes to fire academy students' extraneous load in the classroom?" The extraneous load relates to how the information is presented. Extraneous load can include unnecessary and distracting information. Based on the findings, distractions in learning played a pivotal role in challenging the learning process. Although instructors used learning strategies like hands-on instruction and group work, students reported experiencing distractions and

obstacles that hindered their ability to learn during lectures. These obstacles included the amount of content covered in each class session, storytelling that was unrelated to the course content, students whispering in class, and the lack of a standard form of notetaking.

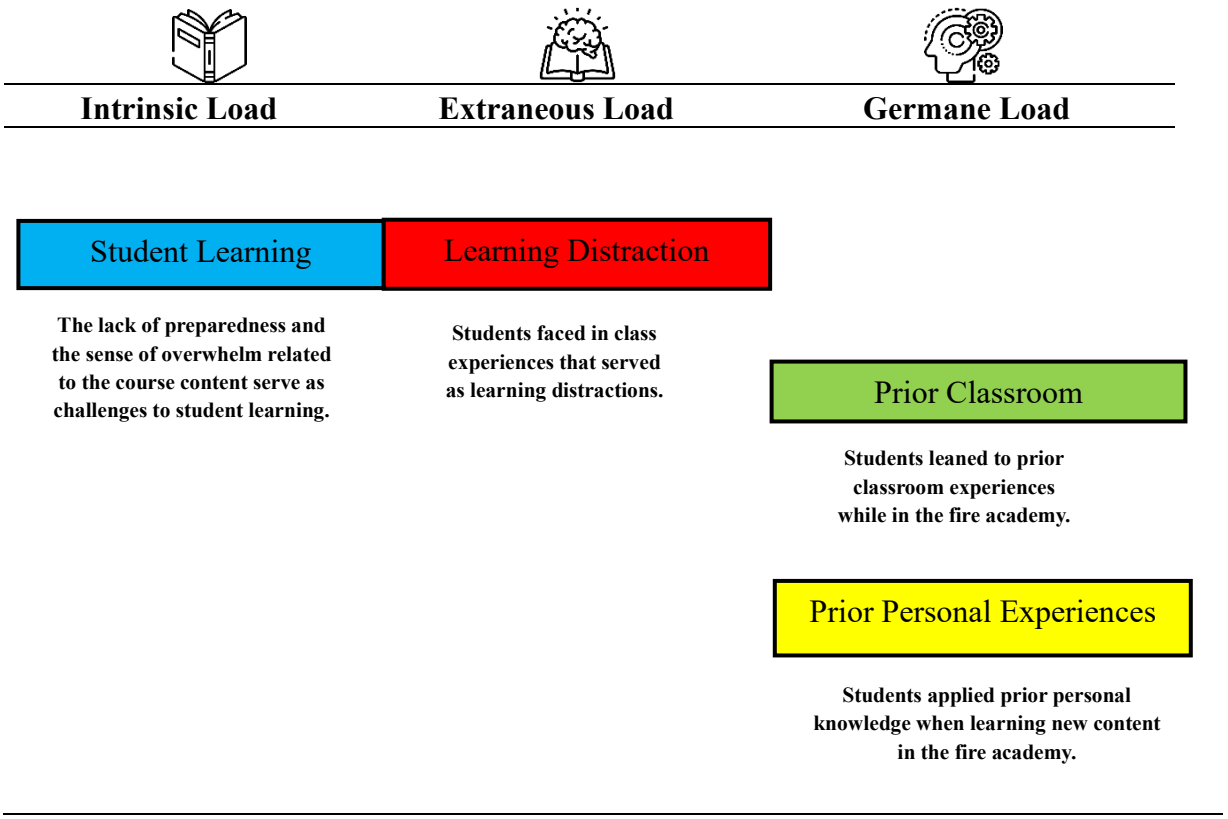
Research question 3. The third research question was, "What are the fire academy students and instructors' perceptions of germane load in the class?" The germane load centers on students' efforts to draw on past learning and personal experiences to process new information. Based on the findings, prior classroom and personal experiences provided students with background knowledge to apply when learning new content. Students utilized previously developed schemas and associated new material with those schemas. Students related past experiences from other college courses and from real-life familiarities with civilian and non-civilian jobs to the fire academy content. It is important to note that the instructors did not share this theme. The instructors did not discuss the students' prior knowledge, nor did they incorporate it into their lectures. They did, however, provide hands-on experiences to provide the foundation for new schemas.

Discussion

Based on the findings, student learning was the central theme shared by the participants, while distractions, prior classroom experiences, and personal experiences were also significant themes. I applied the cognitive load theory to categorize the findings into the intrinsic, extraneous, and germane loads (see Figure 5). Some themes relate to more than one category in the framework.

Figure 5.

Thermatic Analysis Overlay



Results Related to the Framework

The results related to the framework are in accordance with Sweller (1988, 2020) and the intrinsic, extraneous, and germane loads in cognitive load theory. The lack of student preparedness and sense of being overwhelmed stemmed from students experiencing new concepts with large amounts of content over a short period of time. This experience strained the students' intrinsic and extraneous loads. According to Sweller (1998, 2020), students can only handle about three to seven features of topics simultaneously. Additionally, Sweller (1988, 2020) noted that when students reach the top end of intrinsic load, they become overwhelmed and struggle with the distraction of extraneous load. Lastly, students benefited from prior classroom and personal experiences within the germane load. According to Sweller (1988, 2020), the germane load is the students' efforts to use prior experiences to process new information into schemas, thereby storing it in long-term memory. As students draw on their prior learning and personal experiences, prior knowledge can mitigate the effects of intrinsic and extraneous loads.

Results Relating to the Literature

This instrumental single-case study sought to explore the experiences of five instructors and ten students in the fire academy classroom. Reflecting on these experiences provided insight into how each participant encountered both similar and different perceptions of classroom learning. While the instructors and students shared commonalities in student learning, the other three themes were significant only to the students and were addressed in the discussion. Participants were able to share their perceptions of how the lack of preparedness and the amount of course content affected teaching and learning. The students shared that distractions affected them in the classroom, and how they benefited from both classroom and personal experiences related to firefighting. After triangulating the data across multiple sources (Creswell & Poth,

2016), I was able to summarize participants' overall perceptions of teaching and learning in the fire academy and how these perceptions affected their perceptions of classroom learning. I was also able to align the findings with existing research and justify the claims made in the literature review. However, after the existing themes emerged, additional research was needed to demonstrate how classroom learning can be improved.

Instructor strategies. Although not shared by the students, the instructors expressed and demonstrated some best practices in the instruction. Instructors currently use lectures and hands-on learning to support student learning (Bell & Bell, 2018; Gurpinar et al., 2010). The hands-on experiences engaged students in active learning. This active learning entailed coursework that involved experiential (Vasquez, 2018; Walker, 2019) and collaborative learning (Simic, 2012; Summers et al., 2005), team building (Knight & Brame, 2018), case studies (Chakraborty et al., 2010; Flynn & Klein, 2001), and live fire scenarios (Carr et al., 2015; Clausing et al., 2018). According to the literature, these activities promote student engagement by providing opportunities for students to give and receive feedback (Bell & Bell, 2018; Knight & Brame, 2018). As case studies are widely used in firefighter instruction (Chakraborty et al., 2010; Liu, 2009), learning through case studies is student-centered and facilitated by the instructor, and works best in small groups where every student offers ideas or solutions in discussing all possibilities of why the incident happened the way it did (Flynn & Klein, 2001). These aspects of learning begin when the students start their journey to becoming firefighters. Despite the instructors' quality instruction, students still struggled to learn the content. Student learning involves understanding the curriculum presented, enabling students to grasp the information taught during classes.

Student learning and distractions. Student learning in the classroom affects how lesson content is delivered and received. Despite the instructor's efforts, the complexity and volume of the fire academy content, combined with presentation distractions, left students overwhelmed. Based on the interviews, the students' distractions led them to lose focus while in the classroom. While every student learns differently, addressing these distractions directly reduces students' confusion and anxiety while learning. Classroom lectures are only beneficial to the right audiences (Bell & Bell, 2018; Gurpinar et al., 2010). Blended learning (Kintu et al., 2017; Zhu et al., 2021) or flipped classrooms (Akcaryir & Akcaryir, 2018; Lo, 2018; Ozdami & Asiksoy, 2016) with collaboration (Laal & Ghodsi, 2011; Simic, 2012; Summers et al., 2005; Tissenbaum & Slotta, 2019) among students helps to relieve the confusion and anxiety they have during a classroom lecture. Flipped classrooms or blended learning are becoming more popular in higher education. Educational institutions are learning that students are more engaged and perform better in flipped classrooms. One aspect of a flipped classroom that can improve learning is using short video clips that emphasize the relevance to the course material. This relevance uses "seductive details" that are more memorable to students and their learning (Maloy et al., 2019, p. 1). When students took notes during lectures, they were exposed to irrelevant information during discussions. Irrelevant information came in the form of storytelling, in which the instructors became sidetracked by material not part of the lecture topic. Irrelevant information, whether in text or during course discussions, can be eliminated if specific learning tasks are assigned. As instructors develop learning tasks through active learning within the course content, students will not be exposed to irrelevant information (Rop et al., 2017). Regarding note-taking, Flanigan and Titsworth (2020) found that students preferred laptop computers to handwritten notes, but digital distractions remained the primary source of disruption. However, as students tried to be more

efficient with their laptops when taking notes, they missed valuable lecture information (Flanigan & Tisworth, 2020). Note-taking requires multitasking, demanding more cognitive load, and can become a distraction (Fang et al., 2022). Institutions and programs need to find a way to deliver lesson content directly while minimizing distractions to inspire positive learning outcomes in the classroom.

Prior classroom and personal experiences. Prior classroom and personal experience benefited student learning. The students applied these experiences to alleviate the impacts of intrinsic and extraneous loads. Anderson et al. (1978) performed a study with two different groups of college students as they read text within a supermarket and a restaurant and found that each group provided "information that is significant in the light of the conceptual framework, or 'schema" (p. 433). As fire academy students grew frustrated, some asked to return to the main point because they knew the dialogue was going beyond the topic. Students needed the instructor to stay within the topic area. As students learned during lectures and discussions, they developed schemas to recall pertinent information (Anderson et al., 1978). One learning strategy that is still in use today is the K-W-L method. "This is a three-step procedure for the three basic cognitive steps required: accessing what I know, determining what I want to learn, and recalling what I did learn as a result of reading" (Ogle, 1986, p. 565). According to Ogle (1992), the strategy aims to actively involve students by first making the connection between their prior knowledge and the information to be presented in the texts. This is achieved by eliciting what they know about the specific information and how it is likely to be structured. (p. 271) As students learn, they want to be able to relate their experiences with the new information. Once students recall the information, it will remain in their long-term memory. Also, to assist in learning from prior classroom and personal experiences, students collaborated with other students and provided

examples within the topic area to develop schemas or learn new material. From there, they were able to ask questions, which were functions of active and experiential learning (Bell & Bell, 2018; Carr et al., 2015; Clausing et al., 2018; Knight & Brame, 2018). Expanding the classroom experience by incorporating personal experiences will enhance the curriculum and instruction within the fire academy.

Summary and Conclusion

This research study utilized cognitive load theory to explore participants' perceptions of intrinsic, extraneous, and germane load. This study engaged a single case: the fire academy, including instructors and students as participants. The findings revealed that instructors are concerned about students' preparation before class, while students feel that class materials are taught too quickly. This study is significant because it clearly illustrates how the fire academy functions and what contributes to student learning, or lack thereof. Ultimately, this study met its objective of understanding the role of cognitive load and its impact on students' learning in the classroom. Future studies researching cognitive load in other technical programs and courses could be instrumental in learning and organizational change.

APPENDIX A

Theoretical Framework Alignment with Interview Questions Alignment

Table A.1

Theoretical Framework Alignment with Interview Questions Alignment

	Interview Protocol Questions
Intrinsic Load (Student)	1. Tell me a time when you were really excited about a topic and then realized there was more information to learn than you expected. 2. Can you describe a time when you felt overwhelmed with a topic? What was so overwhelming about the topic? Was the topic too much to handle at one time? How did the topic affect your learning? 3. What was it like learning a new topic you had never learned before? Describe how the topic was introduced and then explained in class.
Extraneous Load (Student)	4. Can you describe a specific experience that you had where there were distractions or unrelated material within the classroom? What kinds of things distract you when you are in class? What kinds of things do not distract you in class? 5. How do you set aside learning materials that may be irrelevant to the topic? Do you take notes only from the instructors' presentations and textbook readings? Do you write down your thoughts after participating in hands-on skills?
Germane Load (Student)	6. Can you walk me through a personal learning process you have gone through as a student in a previous course closely related to the fire academy courses? Could you tell me what the previous course was and how the fire academy courses reminded you of it? 7. What is your best way to reflect on past learning experiences with new learning experiences?

Intrinsic Load (Instructor)	8. How much information do you believe a student can learn during one class session? 9. What were some challenges you faced in teaching in the classroom? 10. What learning strategies do you see as lacking or insufficient in the classroom?
Germane Load (Instructor)	11. What are your instructional methods as they relate to student learning in the classroom? 12. When you have students in the classroom, what student learning strategies do you see that could improve? 13. What do you think accounts for improving student learning in the classroom?

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