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Templates for Planning Engaging Secondary Science Class Periods Within a Seven Period Daily Schedule

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by

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DEDICATION

To my mother, father, and wonderful grandmother. Your support and belief in me fueled this endeavor and I am forever grateful.

"Measure twice. Cut once."
- John Florio

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CHAPTER ONE

Introduction

Benjamin Franklin said, "By failing to prepare, you are preparing to fail," and I find it hard to argue that point. I found that two of the biggest requirements to success are some of the most simple. The first being to show up where you are needed to be, and the second being to be prepared. As a teacher, showing up to school each day is the easy part, but being prepared is a bit more involved.

As Minnesota teachers teaching in secondary schools, we need to be prepared for 165 school days, which means at least 165 class periods. Taking into account that many secondary educators teach more than one unique class period each day (ex. Teaching four periods of chemistry and two periods of environmental science each day), that could be over 300 class periods that need to be planned each year. Planning for that many class periods while also trying to keep students effectively engaged in the material is an immense challenge. As a first year teacher planning within a block schedule, it immediately became apparent how monumental of a task planning for the whole year would be. Upon this realization, I immediately wanted to know how to make this more manageable. I realized that while the exact content of each class may change, there could be a template for the different types of class periods that the content could be integrated into. This led me to ask the question: *What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?*

As a science teacher, I like to teach my students to look for patterns and formulas to make the world easier to understand. Using this as my inspiration I began my search for the formula for planning efficient and engaging class periods. This project will benefit teachers, who will have to dedicate less time to planning each class period, and students, who will participate in activities that are more engaging and inline with their attention spans.

In this chapter, I outline how my personal and professional experiences have led me to this project choice as well as the professional application of this project. Finally, I describe the content of the remaining chapters.

Personal Journey

In my personal experience going through middle and high school I had,what I considered to be, a standard class schedule, including seven class periods each day that were around 48 minutes long. While I was not planning any of those class periods, I observed thousands of them. With the time limit set, most classes seemed to have one clear goal. “Today is a notes day”, “Today is a lab day”, “Today is a test day”, and the list goes on. However, aside from some classes having a writing prompt at the beginning of each hour, there was not a clear schedule for each day. This is not to say my teachers were not planning, but their planned schedules were not overtly apparent.

In my professional career as a teacher, I have gotten experience in teaching different class periods. First as a long-term substitute teacher in a school with eight 45 minute class periods each day, and then as the teacher in my own classroom in a school with an alternating daily schedule composed of four 82 minute block periods.

As a building substitute in a public high school, I had the opportunity to observe, support, and teach in classrooms with a wide variety of structures. Grades 9-12, content classes and electives, advanced and standard; I had a chance to see them all. In this wide variety of classes, there were some common themes, but no classes were identical in how they were structured. While each of these teachers completed the necessary coursework to obtain their teaching degrees and licenses, it seems as if nowhere in that coursework was the definitive way to structure a class period.

As someone who has had to plan for both 48 minute class periods and 82 minute class periods, I can confidently say that planning for a shorter amount of time requires a smaller time investment from the teacher, but still a significant amount of time. It feels like keeping a student's attention becomes more challenging with each passing minute. In addition, staying motivated to complete a task while surrounded by your friends would be challenging for almost anyone. Based on these observations, I began to question how class periods could be planned and facilitated more efficiently.

Professional Significance

It is my belief that there is an optimized way to plan a class period no matter the length. In the case of this project, the templates will be created for a seven period day where each class period is 48 minutes long. By understanding the data on student engagement and the most effective methods to keep students focused, a template can be created for the most efficient class period in a secondary science class. These templates will function as scaffolding for planning class periods in which the full time of the block period is broken down into smaller portions based on time and type of activity. Based on the goal of the day's period, the specific activities will be decided upon.

By having these templates available to me, I will be able to plan class periods more efficiently, while also knowing they are planned in a way that has been proven by academic research to most benefit the students. This will allow for more time to be dedicated to all of the remaining tasks and responsibilities needed to be the best educator for my students.

This project will be implemented in my second year of full time teaching. However, I am switching from teaching a life science course at a school that uses a four period block schedule to chemistry at a school that uses a traditional seven period daily schedule. The significance of this is that I will not have any of my previously designed lessons to reuse, and I will be planning for a shorter daily class period. This content and timing switch will be a major adjustment. Having effective templates to use while planning for a new science class will be beneficial to myself as the educator as the planning process will be streamlined leaving me more time to focus on all the other aspects of teaching.

Purpose and Rationale

In this specific study, a review of academic literature will be done into the best ways to structure a secondary science class within a seven period daily schedule in order to keep students engaged and motivated throughout the period. There is no one size fits all plan for planning a class period. The purpose of this project is to create different templates on structuring class periods based on academic research. Each template will vary based on what the goal of the class period is. These archetypes of class periods are: Concept Introduction, Project Introduction, Project Work Day, Exam Review, Exam Day, and Laboratory Activity Days.

The availability of research-based class structure templates will benefit secondary science teachers by allowing them to efficiently plan for each class period based on the specific learning target that day. This project will benefit administrators because they can be assured their teachers are structuring their classes in a way that best engages students and increases their retention of knowledge. Finally, these plans will benefit students because they will be taught in such a way that works with their attention span and developmental needs.

Summary

Chapter One explained both personal and professional explanations of the importance of the question: *What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?* I explained my own connections to this topic stemming from my personal experience as a student and my professional journey as a new teacher. I presented a few of the many reasons why this topic is important to all other stakeholders including other teachers, administrators, and students. The explanations in this section described why the topic of study could be a valuable tool in the planning of curriculum.

Chapter Two dives into the academic research on student attention span, importance of structure for class planning, and how block scheduling impacts overall mastery of course content. The data and research provided in this chapter provides the justification for the schedule of the class period templates.

Chapter Three provides the description of the project including the location, population, and timeline of the project. Chapter Four will present the templates created for each class archetype and present the rationale to justify the efficacy of that specific structure.

CHAPTER TWO

Literature Review

Introduction

There are two prominent types of class schedules within the Minnesota secondary education system, traditional schedules and block schedules. Traditional schedules see students visiting each of their classes every school day for shorter periods of time for a total of 7-8 different classes each day. Block schedules give students alternating days in which they visit half of their classes for a longer period of time for a total of 4 courses each day.

As a student, and during my first position working in a school, I only experienced the more traditional model of school periods. It was not until I began my teaching position for the 2022-23 school year that I was exposed to and began to teach in a block schedule. In fact, during the past 30 years, the switch to block scheduling has been one of the most common changes in high schools across the United States (Lewis, Dugan, Winokur, & Cobb, 2005). This large-scale change led me to wonder about the benefits of a block schedule compared to a traditional school schedule. My current teaching position is structured in a more traditional seven period schedule, however when I began this project I was teaching within a block schedule and as such have collected a substantial amount of research on that type of schedule. I have chosen to leave that information in as it still provides valuable context to this project as a whole.

The literature presented in Chapter Two discusses the following themes: block schedules compared to traditional schedules, student attention span, archetypes and structure of science and class periods, laboratory activities, exams and exam review periods, best practices in science education, and measuring the effectiveness of the project. By considering the previously listed topics, templates for class periods can be developed based on academic research and data to help answer the question: *What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?*

Block Schedules

The first instances of block scheduling within high schools in the United States can be dated back to the late 1800s, with some estimates suggesting that nearly 50% of all high schools in the United States were using block schedules by 1999 (Zepeda, 1999). Proponents of block schedules over traditional schedules claim that in a block schedule students benefit from the decreased amount of daily classes. These proposed benefits are that students have fewer unique classes to focus on each day which allows them to put more effort into the classes they do attend. Additionally, a decreased number of transitions between classes reduces the amount of potential distractions and allows students to remain focused for a longer period of time (Williams, 2011). Those who are opposed to block schedules claim that student attention spans are not capable of the needed level of focus for extended class periods, and that the additional difficulty of planning for longer class periods leads to teachers assigning more busy work to fill the class period (Williams, 2011).

Aside from these claims and opinions of educators, numerous reports have been done comparing the testing and achievement scores of students participating in traditional schedules compared to those in block schedules. A 2009 study conducted in Florida public schools showed that under a traditional schedule, standardized reading scores were lower than for students in a block schedule. Conversely standardized math scores were higher for students in a traditional schedule compared to a block schedule (Williams, 2011). A study done by Knox County Schools in Tennessee also studied the differences in student achievement between schedule types and did not come to the conclusion that either type had a significant and clear advantage over the other (Sattler, 2019). What we can learn from this data is that some students responded better to block schedules than others. Some classes saw high average grades when implemented in a block schedule, some saw lower average grades. Based on these studies, no type of schedule has a clear academic benefit over the other.

An additional study was conducted by Louisiana Tech University to research the effects of a block schedule on ACT scores, graduation rates, and student attendance. This study was conducted over the course of 12 years within three different high schools. It provides valuable insight into how different scheduling can impact the same specific schools, rather than comparing two different schools on different schedule types (Clark, 2021).

In this 12 year period, all three schools transitioned from a traditional schedule to a block schedule and then transitioned back to utilizing a traditional schedule again (Clark, 2021). The data collected showed a significantly higher graduation rate during times of traditional schedules, and insignificant differences in ACT scores and student attendance between times of traditional schedules and times of block schedules. (Clark, 2021).

The research shows that there is no inherent advantage to a block schedule compared to a traditional schedule. In some cases, block schedules even result in lower student academic performance. This shows that simply extending the class period is not enough to help our students. Block schedules are not more beneficial to students and staff than a traditional schedule if they are not being utilized properly. In the same way, traditional schedules aren't more beneficial than block schedules. As we learn that this type of daily schedule does not inherently boost a students performance or understanding of course content, it becomes apparent that how teachers utilize the assigned time they have with their students is more important than the length of that time. This highlights the need for a plan to be put in place for formatting these class periods so that they are being used as effectively as possible.

Student Attention Span

In a class period that is 48 minutes in length, it would be unreasonable to expect students to focus completely on just one task for that entire period of time. I have yet to meet a teacher who structures their class in such a way. When it comes to developing templates for planning individual class periods, it is important to understand student attention span and just how long we as teachers should expect a student to be able to focus on an individual task.

It has been a common belief that the average attention span of humans has decreased. This is not entirely true, however, as a recent study done on attention spans shows that the ability to focus on a specific task varies based on the task and the person (Subramanian, 2018). Recent decreases in attention span were identified and quantified.

Additionally, a correlation between that decrease in attention span and the increase in personal electronic device usage was also found (Subramanian, 2018).

While exact percentages on decreased attention spans have not been identified, phones (and other technology to a lesser extent) have been found largely responsible for current average abilities to focus on a task. A recent study found that 77% of surveyed young adults reach for their phone when they are bored and 52% check their phone every 30 minutes or less (Subramanian 2018). If that statistic were extrapolated to a 48 minute block schedule, then we would expect that over half of the class would (or would be tempted) to disengage from the lesson or activity and check their phone at least once per class. Based on this data it is tempting to assume that simply removing smartphones from schools would keep students engaged with their lessons, however, further research on the topic of attention spans suggests the solution may not be so simple.

Among teachers and academics, it had been commonplace to hear about something called the “10 Minute Rule” in terms of how long a student could reasonably be expected to focus on a task (Langstrom, 2015). That is roughly 25% of a standard class period and just about 12.5% of a block period. In recent years, those 10 minutes have been decreased to 6 and so the new “6 Minute Rule” came to prominence (Langstrom, 2015). Based on this new rule the percentage of a traditional class period that students could dedicate to a single activity dropped even more (Langstrom, 2015).

To test this “rule”, a study was done to track how long university students watched an assigned video before pausing/taking a break. Students were tasked with watching a video that was between 50-70 minutes long and a computer program tracked their activity while watching the video. Data collected from the 20,141 watching sessions found that the median watch time (time focused on the video) was 12.5 minutes. In addition to that, the study found that students were likely to come back to the assigned video, and 90% of the subjects were able to watch it in its entirety throughout the course of multiple viewing sessions (Langstrom, 2015).

This study teaches us two important things about student attention span. The so-called “Six Minute Rule” is not law. Students are capable of focusing for a longer period of time. This does not mean that they can be or should be expected to focus for exactly 12.5 minutes on each activity. Additionally, this was a study conducted on college students, not high school students so it is safe to assume some difference in exact expected attention span. Secondly, it demonstrates that students can complete a task that takes an extended amount of time when it is broken into smaller, more manageable pieces.

Just as important as teachers noticing lapses in student attention span are students reflecting on their own abilities to stay focused during class. A 2010 study asked students across three different college chemistry courses to record their own focus during a series of 12-minute lectures across multiple class periods (Bunce, 2010). This study focused on answering three factors: students reporting their own lapses in attention, the length of time attention waned, and the influence of pedagogy on attention lapses (Bunce, 2010). Students were given a clicker device and asked to record their attention lapses during lecture as soon as they realized their focus had wandered from the lecture. Each time they recorded their loss of focus they had three options of losing focus to choose from: one minute or less (short), two-three minutes (medium), five or more minutes (long). Data was collected for each course over six weeks (Bunce, 2010).

The results of this study show that the highest occurrence of self reported attention lapses occur at the 4.5 minute mark and then again at the 9.5 minute mark with the majority of students reporting a short (one minute or less) break in attention at these times (Bunce, 2010). Additionally, in courses where the instructor incorporated a demonstration as part of their lecture, average reported attention lapses significantly decreased immediately following said demonstration (Bunce, 2010).

Collected data has found that students have been shown to be able to focus on an individual work task for roughly 12.5 minutes at a time (Ferlazzo 2015), and focus on a traditional lecture for the first 4.5 minutes on average before losing focus (Bunce, 2010). Using these two time frames we can begin to piece together our 48 minute class period schedule.

A 2007 experimental study from the University of Rome looked to understand the effects of a phenomenon closely related to attention span known as “attention blink” (Ferlazzo, 2007). Attention blink refers to the decreased ability to identify the second stimuli when two are presented in quick succession. This study specifically examined how attention blink is impacted when two different tasks are assigned at the same time, compared to one task being assigned at a time (Ferlazzo, 2007).

In this experiment, test subjects were sorted into two groups: the control and the experimental group. Subjects in both groups were asked to quickly identify two letters appearing on a computer screen as quickly and as accurately as they could. The control group was told to identify each letter as it appeared. The experimental group was asked to identify the pair of letters (meaning they could only report what letters they had seen after both had been shown). Both groups were given two tasks to complete (identifying two different letters), however, the experimental group was given both of those tasks at the same time (Ferlazzo, 2007).

The results showed that test subjects in the control were more accurate and quicker in identifying the given letters compared to the experimental group. Important to this study is the idea that these subjects were asked to do the same thing, but when their attention was taken away from task one just to hear about a future task, performance suffered. In order to maximize student attention on their tasks in a given class period they should be given out one at a time.

Taking into account the data collected about student attention spans, the appropriate amount of time can be given to the different segments of class within each template. This will ensure class time is being used effectively and moving at the appropriate pace. Keeping each section of the class template at or under the recommended duration will aid and increase student engagement during the block period.

Understanding block schedules and student attention spans are good first steps in developing templates for class periods. The next section will explore the different types of class periods for secondary science classes and the unique needs they present.

Archetypes and Structure of Science Class Periods

No two class periods are or should be the same. However, within secondary science classes, there are certain archetypes that each period can be sorted into. By identifying each archetype and how that archetype of class is most effectively implemented, a template can be created for each type of class period.

Class archetype refers to the general goal of the class period and the activities that help students and teachers reach those goals. For example, a class period that's goal is to learn about a science concept through following procedures, making observations, and recording and analyzing data would be considered the Laboratory Experiment archetype.

For this project, the archetypes that will be used to create templates are as follows: Concept Introduction, Project Introduction, Project Work Day, Laboratory Activities, Review Days, and Exam Day.

Establishing routines is an important part of running a successful class period. Education writer James M. Lang argued that the first five minutes of class are crucial in setting the day's tone. Each class should begin with questions to be answered by the students that either challenge students to recall what was done in the prior class period or activate prior knowledge from a previous course that is relevant to the day's objectives (Lang, 2016). The benefits of this are twofold as it asks students to be engaged immediately in the day's objectives and provides practice in the skill of recalling information which is necessary for exams.

Additionally, Lang suggested that students write their answers to these questions down on paper. This ensures that students are actually attempting to answer the questions and provides low-stakes writing practice that is often missing from science classes (Lang, 2016).

The practice of starting each class period with answering questions can and should be implemented for each of the class period archetypes.

When giving instruction using diagrams, the concept of cognitive load theory should be integrated (Chandler, 1991). Cognitive load theory suggests that effective instructional material facilitates learning by directing mental energy toward activities that are directly related to learning objectives and minimizing steps or distractions that are not relevant to the learning goals (Chandler, 1991).

An experiment conducted by Chandler and Sweller (1991) tested cognitive load theory by presenting electrical engineering students with two different forms of instructional materials for testing electrical installations (Chandler & Sweller, 1991). Both groups were given the same diagrams and same instructions. Group one (the control group) was given their information in the more traditional format, with all the steps for testing the installation listed and then the labeled diagram was presented. Group two (the experimental group) was given the steps required directly on the diagram (Chandler & Sweller, 1991).

When both groups were tested on the installation process, the experimental group scored higher on both the written and practical exams. The reduction in cognitive load by not having to switch between instructional steps and the diagram they referred to by having the instructional steps included directly on the diagram, resulted (Chandler & Sweller, 1991).

This demonstrates that when giving instruction during class periods, those instructions must be as lean and condensed as possible to reduce cognitive load. Diagrams should be integrated directly into instruction rather than divided into separate sections. The concept of cognitive load theory should be implemented during concept introduction days, laboratory experiment days, and project work days.

Just as important as how class is started is how it is finished. Students should be given a clear objective at the end of each class period that either helps them reflect on that day’s learning or prepares them for the next day’s task.

In his research, James M. Lang described the importance of ending a class with a writing activity. Both as a way to prevent students from packing up their things early and to review. Thankfully, there are multiple options for engaging students before the period ends (Lang, 2016). Some examples are the "Minute Paper", in which students take a minute or two to answer to questions about what they have done or learned that day, "Closing Connections" in which students are required to write five different ways that day's topic connects to current events or their personal lives, or the "Metacognitive Five" in which students are asked to assess their own study and review habits, this is most effective when implemented near the date of a test (Lang, 2016). There are a variety of ways to engage students before they leave class, but it is important to make this an established part of the routine.

Laboratory Classes

While the previously listed archetypes of a class period can be found across different subject areas, science courses are unique in that they host laboratory experiments. Lab experiments are hands-on and engaging but require a higher than average amount of time dedicated to instruction on procedures and safety concerns (Unal, 2013). It is for this reason that having a set structure for running a lab period is important.

Research has suggested that the best way to keep students engaged during a lab experiment is through problem-based learning (Unal, 2013). Problem-based learning goes against the traditional teaching trope of learning a skill or equation, and then being presented with a problem to solve using those learned tools. Problem-based learning is a method of teaching in which a problem (often a real world example) is introduced to students to get them engaged in the lesson. Students then identify what they need to know in order to solve the presented problem. Finally, they learn the skills they identified and then formulate the solution. After this problem is introduced, then the tools (Duch et al., 2001).

Traditionally there has been a disconnect between what teachers expect of students during laboratory activities, and what students *think* teachers expect. Students are more concerned with getting the perceived "right" answer than actually following the lab procedure and interpreting their results (Unal, 2013). To counteract this and ensure students are actively engaged in the lab experiment, it is suggested that problem-based learning is implemented.

In Unal's research, he found that students were most engaged with a lab when it began with a real-world problem related to the activities goal. By having students first make a connection to life outside of science class they are immediately shown the relevancy of the activity (Unal, 2013).

Establishing a real world connection between the laboratory activity is the best way to get students engaged. Once that engagement is established, the laboratory activity must meet four requirements. 1. The experiment must be safe 2. It must be at the correct grade and course level 3. It must be capable of being performed with the usual, simple equipment available. 4. Its completion must be practical within the course of the block period (Blosser, 1980).

After planning a laboratory activity within those parameters, teachers must actively facilitate. This starts with an introduction and then a demonstration of the key techniques and use of equipment that will be utilized during the course of the period.

Educators must then maintain an active role by continuing to check in with students and facilitate until the closing activity (Allen et al., 2009).

Science labs can cover a wide range of topics and vary widely in their goals and procedures. However, by keeping these points in mind the planning and implementation of laboratory experiments can be simplified.

Exam and Exam Review Periods

Exams are a common occurrence across all traditional secondary school courses. Ideally students should be given enough time to finish the exam within the class period, but not too much time where they are left with nothing to actively work on after they have completed their exam. While each scholar is unique in how long it takes them to finish exams, the general rule of thumb is that the test will take students three-times as long to finish the exam as it takes for the exam writer (teacher) to complete it (Clay, 2001). Another way to consider planning exams is to use the following time requirements based on question type:

- 30 seconds per true-false item
- 60 seconds per multiple choice item
- 120 seconds per short answer item
- 10-15 minutes per essay question

(Clay, 2001)

In the included templates for exam days, 30 minutes of the class period is reserved for students to complete the exam (with the remaining time in the period designated for bell work and final review). Using the methods above, this means your exam should take the exam writer 10 minutes to complete or contain questions whose amount of time required to complete are equal to ~30 minutes based on the values above.

Due to the high variety in out of school life for students, it should not be assumed that students have the ability to study for exams after they have left your classroom. This is why it is recommended that time in class is given for exam review and preparation. Educators should give students a very clear idea of what to expect on the exam, such as time given to complete the exam, the number and type of questions, and the concepts that will be covered. The amount of time given to prepare for the test can be assigned at the discretion of the educator based on the contents of the test. Templates are provided for multiple days of review, but that is not required.

Best Practices in Science Education

After class periods are planned it is still necessary for teachers to facilitate that plan. While there are tried and true methods of executing curriculum across all subjects and grades, in science classes there are specific methods proven to be effective for science content.

Some students may come into your classroom with a passion for science and an intrinsic force that encourages them to engage with the lesson and learn. However, that is not the case for all secondary science students. With that in mind, it is our job as science educators to motivate students to learn and engage with our prepared curriculum. “If students are to derive the intended learning benefits from engaging in an activity, their interest in or recognition of the value of the activity needs to be motivated” (Kesidou and Rosemound, 2002). To truly engage students with our lessons, we must grab their attention by connecting that day's concept to something in their own lives. Furthermore, while this connection should be established during the beginning of the lesson it must be consistent throughout the class period.

Motivational factors can be sorted into two categories, intrinsic and extrinsic. Intrinsic motivating factors within science courses come from a student's desire to understand a scientific phenomenon. This relates back to the importance of engaging students early by connecting concepts to their daily lives. Extrinsic motivation factors within school settings are more closely related to things such as test scores, class grades, and project deadlines. Finding a balance between these two types of motivators is key to engaging students (Banilower et. al, 2010).

After student motivation is achieved, perhaps the most easily implemented and most effective practice when teaching science content to secondary students is implementing "student talk". Student Talk is when the teacher takes a break from lecturing or demonstrating a concept and allows students to converse with each other about the topic (Bruski, 2019). The benefit of student talk is twofold. First, students are able to practice and develop their communication skills. Secondly, this gives the educator time to assess student understanding or clarify individual questions during this time (Bruski, 2019).

To effectively implement student talk in the classroom, the procedures and expectations must be modeled and explained to the students. To effectively facilitate student discussion, teachers should have a list of discussion questions prepared and easily displayed for all students to see. There must be appropriate time allocated for students to fully discuss and answer the question(s). Finally, the classroom community must be such that students can express their ideas safely (Bruski, 2019).

Student Engagement

A planned lesson could contain all the necessary content and tools students need to succeed, but if those students are not engaged it does not matter. Within the planning of each class period student engagement must be considered. Keeping students engaged not only increases their own learning, but also decreases the likelihood of them distracting their peers with off topic activities.

Research from Stanford University's teaching commons suggests the following methods to keep students engaged in class activities.

There is a natural anxiety that comes with answering questions in front of the class. This can be especially true in science classes where there is often a definitive correct answer to each question. To counteract that fear and build confidence in students, it is suggested that the educator incorporate open-ended questions. Open-ended questions can ask students to justify an opinion or interpret a reading. These types of questions are more likely to elicit responses even from those who do not fully understand a formula or know the definition of a key term because there is no risk of “failing” this type of question. Additionally open-ended questions can have multiple correct answers or perspectives which can lead to a more rich class discussion. Implementing open-ended questions as part of the bellwork each period is a great way to get students engaged and build their confidence as soon as class begins (Baur, 2007).

Additionally, students should be taught to reflect upon their own work and learning. Offering students a chance to evaluate their own learning in an honest way, with no penalties for admitting that they are struggling or could do better, is an important skill for students to learn in order to continue to make progress within the subject area.

Self-reflection activities can be incorporated at the end of a unit, or at the end of the class period as that day's exit activity.

Finally, when possible and practical within the day's time constraints, students can be given the chance to explain a concept or process to their peers. This can be a scheduled activity through methods like Think-Pair-Share during scheduled class time, or can occur naturally during large group instruction. Giving students the chance to teach their classmates builds confidence in the student who is sharing, and may provide the course materials in a context the other students may more easily understand. Teachers may interject at their discretion and must be sure to correct any inaccuracies that the sharing student may present (Stepnyan et al, 2009).

By incorporating these suggested strategies within the provided templates, students will be more engaged during the class period. Keeping all of the previous topics in mind, we will be able to create templates for planning the different types of class periods. After these templates are created and implemented it is important to monitor and judge how effective they are. In the final section of Chapter 2, the parameters for measuring effectiveness will be outlined.

Measuring Effectiveness

After utilizing the research on block schedules, student attention span, and the different archetypes of science classes, a series of templates have been created for planning science class periods. In order to determine if these templates are a useful tool, their effectiveness must be analyzed. If the templates are being optimally used, then students are learning the assigned content and completing the assigned classwork and activities within the class period. It may seem simple to use class grades to judge effectiveness of the class periods, however, that should not be the only metric used to measure success. Analyzing class grades and summative assessment scores are just one way to assess how effective these templates are.

An important aspect in judging success in this project is to distinguish the feeling of learning compared to the actual learning of new scientific concepts within the classroom. A 2019 study from Harvard University looked to measure the difference between the two (Deslauriers, 2019).

Two different groups of physics students were asked to complete a quiz after attending different types of class periods that employed different teaching styles; a traditional lecture and active learning. In addition to the end of class quiz, students were asked to rate how much they felt they learned. For both types of class periods, the average test score out of 1.0 and the self rating of how much the student learned on a scale between 0 and 1.0 (with 0 being nothing learned and 1.0 being the maximum amount learned) were within 10 percent of each other, demonstrating that students in general know to what level they are being taught in science courses (Desluriers, 2019). What this means in terms of this project is that students are fair judges of how much they are learning and communicating with them can provide helpful insight into how effective the class period is.

Success can be seen in test results and through student reflection. In addition, teachers know they are succeeding when they see their students engaged in the day's activities. A 2012 study compared different methods of measuring student engagement to determine which method most accurately reported the levels of student engagement (Fredricks, 2012).The methods of analyzing student engagement were: student self report, experience sampling, teacher ratings of students, and student interviews (Fredricks, 2012).

The results show that each different method has its own strengths and limitations. Using mixed methods of judging student engagement will give the most complete picture for understanding class effectiveness as a whole (Fredricks, 2012). Based on the ease of administering each of these engagement analysis methods, it would be recommended that self assessments be administered once a week as part of the closing five minutes writing exercise. Teachers can then use this reflection data to assess what concepts were learned and which need additional time. Teachers should randomly select a small group of students that represent different academic achievement levels and record their level of engagement once per week. Additionally, select students should be interviewed at the end of each academic quarter about their engagement levels during different types of activities.

By identifying the most efficient ways to measure the effectiveness of the created templates, edits and adjustments can be made to further increase their benefit to the students and teachers. Using different aspects to measure these templates will allow for this project to be edited and adapted in future iterations to ensure its effectiveness for students.

As a streamlined initial measure of effectiveness throughout the semester, data will be collected on the percentage of students who have missing work. This relates to an effectively planned class period in that if students are engaged during class periods, then they will complete their assigned class work at a higher rate.

Conclusion

This chapter has explained the history and proposed benefits and drawbacks of bell schedules, delved into studies on student attention span, and defined archetypes of science class periods. Using that information, templates for effective class periods have been designed. Finally, the measures of determining effectiveness of these templates has been outlined.

Chapter Three builds upon literature and research referenced in this chapter to outline and describe the goal of this capstone project. The need for this project as well as the projected benefits will be highlighted.

CHAPTER THREE

Project Description

Introduction

To continue to answer the question of, *What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?*, lesson planning templates have been designed using the data highlighted in the literature review. These templates have broken down a 48 minute class period into smaller sections of time in which related activities can be inserted during the planning process. After the project description is presented, the template design chapter is divided into several sections. First, the setting and school population gives a brief overview of the school where this project will take place. Next, the participants section gives specific information about the students I work with and the role of both teacher and students in this project. The timeline section then describes when this project will be implemented. The assessment on effectiveness section describes how success is measured in this project. Lastly, the template outcomes section lists the benefits of this project to teachers and students when implemented.

Project Description

This project consists of five different templates that can be used by secondary science teachers for planning class periods within a 48 minute 7 class period schedule. In the context of this project, a template is scaffolding for planning a class period broken into several time based sections. The sections are defined by individual goals that can be adjusted based on that day's content and academic standards. The templates are as follows:

- Concept Introduction: This is a class period where the main objective is to introduce a new class concept to students and engage them in the material.
- Laboratory Activity: This is a class period where students get hands-on with science concepts by following procedures to observe science phenomena and collect and interpret data.
- Project Introduction Day: This is the class period in which a summative project is introduced to students. The goal of summative projects is for students to demonstrate their understanding of learned class concepts.
- Project Work Day: This is a class period dedicated to working on and/or completing an assigned summative project.
- Exam Review: These are class periods dedicated reviewing and relearning necessary concepts before the in class exam. The number of days dedicated to review is determined by the educator.
- Exam Day: This is the class period in which students complete their science unit exam to demonstrate their understanding of learned concepts. The length of the block period allows for review time in class before beginning the exam.

Each of these templates will break the 48 class period into smaller timed sections in sequence that has been shown by academic research highlighted in the previous chapter to be most effective at keeping students engaged and on task.

Setting and School Population

This project takes place in a public high school serving grades 9-12. This school is in the first ring suburb of a large city. There are 916 students who attend this school. The total minority enrollment is 71%, and 44% of students qualify for free and reduced lunch. The graduation rate for students at this school is 93%, which is above the state average.

Student math proficiency is at 51% based on standardized tests. Reading proficiency for Students is at 42%. Science proficiency for students is at 24%. All of these percentages are below state averages. Reading and mathematics proficiencies will be taken into account to assure that any assigned readings or calculations are presented at appropriate levels.

The science department consists of six teachers, myself included. There are two teachers for each of the core science classes (biology, chemistry, and physics), with each teacher also teaching a science elective course.

Participants

The participants in this project will be me, as the facilitator and data collector. My chemistry students across four class periods will be the test subjects in this project. They are 10th grade high school students in a standard level class. These are not advance placement (A.P.) or International Baccalaureate (I.B.) courses.

The intended audience for this project is fellow secondary science teachers who teach within a seven period daily schedule. While I will be using these templates for chemistry classes, they can also be applied to other secondary science classes such as biology or physical science.

Timeline

The class schedule templates were developed during the Summer 2023 semester. This project will take place during the Fall 2023 semester. Data on missing and late work will be collected at designated checkpoints during the semester. These data collection checkpoints will take place every four calendar weeks and at the end of each scholastic quarter. A final assessment of effectiveness will be conducted after the end of the Fall 2023 semester.

Assessment on Effectiveness

The main measure of effectiveness will be examining the percentage of students with missing and/or late assignments. The assumption is, if students are engaged during class periods, then they will complete their assigned class work at a higher rate. This project will be deemed a success if the average percentage of students with missing and late work is less than 15 percent across all checkpoints.

Supplemental data could also be collected using mixed methods approaches. These will include teacher reflection, student self-reflection, student interviews, teacher observation, and average class grades.

Template Outcomes

Class template designs are based on the goal of most effectively utilizing the 48 minute 7 period daily class schedule to keep students engaged during each period. Successful use of these templates will result in:

1. Reduced planning time needed for each class period by the educator.
2. Low percentages (<%15) of students with missing or late classwork.
3. Low percentages (<%15) of students with a cumulative course grade of under 60%

Chapter Summary

Chapter Three has outlined the goals of this project and the research that supports the need for this project. Project setting, student demographics and standardized test scores, project participants, intended audience, the timeline for project implementation, and methods of determining effectiveness have also been detailed. Chapter Four will reflect on the process of creating this project, what I have learned through my research, the limitations, and future applications of this project.

CHAPTER FOUR

Overview

Throughout this project, I have been working to answer the question, "*What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?*". At the start of this project I was working at a school which implemented a four period block schedule, however since beginning the project I have accepted a position at a school with a seven period day. While this change did have some effect on my project and the templates that were created, the core focus on student engagement and attention span remained.

Using academic research and literature, I assembled planning templates for individual class periods. Editable Google Slides that correspond with each different type of template are also available for use. The goal of these templates and Google Slides are to allow teachers to efficiently plan class periods in a way that keeps students engaged and on task.

In this chapter, I will begin with a discussion of what I have learned over the course of this project. I will then detail the limitations of this project. Next, I will discuss the benefit of this project to the secondary science education community as a whole. Finally, I will conclude with how the project can potentially be adapted and applied in future scenarios.

Major Learnings

I originally became interested in this topic as a first year teacher who was a student teaching in my own classroom. In addition to not having a consistent mentor teacher, there were no other teachers at the school who taught the same courses as I did. The school provided a curriculum, however it was limited and not fit for that school's specific 82 minute block schedule. As a result of these circumstances, I found myself dedicating a large portion of my time towards planning each class, and even after investing a significant amount of time in planning, noticed that overall students had trouble remaining on task as we got further into each period. As I went through these growing pains, I became interested in finding a way to make planning each class a less time consuming affair, as well as understanding more about student attention span and engagement.

While not initially planning on it, I found myself getting into certain routines in how my class periods ran each day. More often than not, the class periods began with a bell work activity, transitioned into the introduction of that day's activity, then came the time to work on the assigned task for the day, and on some days ended with an exit ticket activity. In order to save time in my daily planning, I often found myself copying and pasting Google Slides I had created and editing them to fit that new class period's specific goal. After making the realization that I had fallen into a general pattern for planning each class, I began to think of a way to refine this practice into something more structured and engaging. This is what led to the decision to create planning templates and accompanying Google Slides that were based on academic research.

As I began my initial research I was happy to find a wealth of information on the topics of student attention span, and best practices for student engagement. What was not present were templates that had taken these two variables into account for the purpose of planning each class period. This indicated to me that my project goal would be able to fit a specific gap in the academic planning space.

Researching attention span in students was particularly interesting to me. It seems as if the decreased attention span in students, and in humans in general, in recent years was an accepted phenomenon amongst most people. As a science teacher, I know the importance of not accepting something as fact just because most people agreed on it. That is why I found it refreshing to see scientifically collected data that supported this widely accepted idea. Having these specific data points to reference made the division of time between class activities a streamlined process, especially when working within a 48 minute seven period daily schedule.

Looking into best practices for student engagement was also helpful, though the research was less surprising than that on attention span. This is largely due to the fact that these suggested engagement methods were commonplace amongst various courses in Hamline's MAT program. The importance of concepts such as bellwork and having a hook to get your students invested had been instilled across multiple classes in this program. It was helpful to see the specific research associated with each of these practices that illustrated their specific benefit. By combining this research with the information on student attention span, I feel like I was able to implement each of these practices to their fullest potential.

Using the summation of my research I was able to craft templates and corresponding Google Slides for the different types of class periods within a secondary science class in a 48 minute seven period schedule.

Limitations

Perhaps the most apparent limitation of this project, is that the templates are based on my current school's specific schedule for class periods, 48 minutes on Mondays, Tuesdays, and Thursdays, and 42 minutes on Wednesdays and Fridays (these shorter class periods are due to the additional advisory period given to students on those specific days which take six minutes away from each of the other class periods). While this project could be adjusted based on teacher needs for schools within similar class period lengths (ex. 45-60 minute long classes), trying to implement this schedule in a block schedule would require much more work and larger edits to existing templates.

Research shows that students have a harder time focusing and remaining engaged during extended periods of time. It is perhaps the most simple solution to give students extended work time to fill up these longer classes, however based on the collected academic research and data, students can not reasonably be expected to fully utilize these inflated independent work times. This would require additional class segments being added to keep students engaged during the additional time in the class period.

Additionally, the data collected from the literature review was done in general classroom settings. None of the studies spoke explicitly on how factors such as gender, average household income, culture, or location can impact student attention span and best engagement methods. Keeping this in mind, it is possible these templates may not work best for all student populations across diverse school settings. That being said, these templates can be used as a starting point for all secondary science teachers. Educators using these templates are encouraged to make any changes that they feel better serve their students' learning.

Finally, these templates were created for the standard class period days consisting of either 48 or 42 minutes. During nonstandard days (such as half days or early dismissal due to weather), educators will need to adapt their planning to fit within these unique time parameters. Additionally, as most teachers know, every day will not go exactly as planned. Some activities may go quicker than expected, some may take longer than planned for. If this is the case, teachers should use their best judgment in either cutting sections of that day's class, or finding ways to extend certain portions.

Benefits to Science Education Community

Secondary science educators hold many different responsibilities in their roles and it sometimes feels as if there is not enough time in the day to complete every necessary task. It is my hope that science educators who utilize these templates see a decrease in the amount of time spent planning each class. This in turn will may reduce the amount of time they spend working while not on site at their school if they find themselves taking work home frequently, and will free up time during the school day that allows them more time to build relationships with students, communicate with families and fellow teachers, and invest time in their other important responsibilities.

In addition to benefiting teachers, these templates are structured in a way that research has shown to make it easier for students to remain engaged. When implemented correctly, this will lead to higher levels of content retention and higher performances on assignments and exams. With students learning and retaining more information during the class period, they will have more time outside of school to dedicate to responsibilities such as work or taking care of family members.

Future Directions

As stated above, these templates, as exactly written, may not be the best fit for all schools depending on schedule timing or other unique factors. It is exciting to think of the possibility of teachers editing these templates to best fit their own courses, school populations, and teaching styles.

As a science teacher, I always remind my students that in science we are never 100% sure of anything. This is because there is always the chance of new information being discovered that changes our understanding. These templates were created based on current research on attention span and student engagement. If and when new research is done on these topics, it is possible that our current understanding will shift and these templates will need to be adjusted to fit the new information.

Finally, while these templates were created for secondary science classes, many of the templates (excluding those for laboratory activities) could potentially be applied to other secondary classes within a 48 minute seven period schedule.

Summary

This capstone project was designed to answer the research question, *What are the most effective ways to structure the different types of secondary science class periods within a seven period class schedule?* I began this chapter by discussing the experiences that led me to choosing my specific research question. After that, I reflected on my literature review and how the information from those sources guided my template creation. I then discussed the limitations of this project. Next, I discussed the potential benefit this project held for the science education community at large. Lastly, I discussed the future possibilities for this project and acknowledged the potential changes that could be made based on new information. Overall, these created templates and their accompanying Google Slides are a great resource for science teachers who are looking to efficiently plan engaging class periods within a seven period daily schedule.

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