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WHY WE PLAYED WIFFLE BALL ON WEDNESDAY

Timothy Abraham & Katie Hanifin, *Utica University*

The decision to move away from lecture-led instruction in the college classroom is not simple. Planning for and managing a more interactive classroom brings unique challenges and opportunities. A biomechanics instructor and an instructional designer from Utica University compared teacher-led instruction to brain-based instruction and share their brain-based class redesign.

Timothy Abraham is an Associate Professor of Physical Education, Exercise and Wellness Studies at Utica University. He earned his bachelor's degree in Kinesiology from the University of Illinois - Chicago, and his master's degree in Kinesiology from the University of Illinois - Urbana Champaign. Abraham teaches courses in adventure programming, physical education, and exercise science, and his scholarly interests lie in effective teaching and learning practices, especially in non-traditional settings or using non-traditional methods.

Katie Hanifin is an instructional designer at Utica University. She believes that learning, at its heart, should be fun. This is a topic she's explored while writing for EdWeek.org and EdTech magazine, with her research in Massively Multiplayer Online Role-Playing Games, in her classroom as a former public schoolteacher, and in her office at the Utica University Center for Innovative Learning.

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THE PATH

Assistant Professor Tim Abraham messaged instructional designer Katie Hanifin from class one early fall day, "I'm giddy right now. Playing wiffle ball in class. After each inning, teams must discuss an assigned biomechanics principle. LOTS of great discussion."

This is the story of how we got here, of why we played wiffle ball on a Wednesday. It begins with an inexperienced professor recognizing that his traditional teaching methods were not accomplishing the learning goals of a typically third-year undergraduate, on-campus, biomechanics course. This is about how the redesign of one course influenced another and how an instructor and a designer can collaborate to re-energize the teaching and learning across a program.

Like many new to academia, Professor Abraham's educational background in kinesiology and 20-plus year clinical background in sports medicine prepared him as a content expert but not a teacher. Besides trying to manage everything involved in the first semester of a new career environment, he was charged with designing all his courses from scratch.

For Abraham, it was logical to follow the most acceptable, and familiar, instructional plan. That is, sit down with an agreed-upon text, build out coordinating slides, and teach the class by leading students through the information. However, as the semester wore on, it became clear to the new professor that the expressions on many of his student's faces as they sat idly in their seats would not lead to effective learning as he had hoped. In search of answers, he sought out assistance from Utica University's Center for Innovative Learning, where he met with instructional designer Hanifin.

Hanifin started teaching 20 years ago in a middle school classroom. Like many new teachers, she too was handed a book and given a general overview of which chapters the students should complete. Because the subject was language and culture, her teaching very soon felt incongruent with the organic, interpersonal, and lively nature of authentic language practice and acquisition. The assigned textbook facilitated listening activities and writing activities, but none were authentic to true immersive learning experiences. This led Hanifin to an interest in instructional design. Eventually, she left teaching and became an instructional designer and her work at Utica University has been centered on innovative immersion. If the class experience is to become active, immersive, and authentic, then an instructor needs to shift their energy toward planning such activities for student participation.

THE DESIGN PROBLEM

Lectures, like the ones Abraham initially developed to teach his course, are common in academia, with 63-88% of college class time spent using this approach (Alhirtani, 2020; Rutkiene & Tandzegolskiene, 2015). In this traditional design (see Figure 1), instructors plan their lessons before class. For Abraham, this meant building out publisher-provided slides, creating talking points, and trying to polish his lectures to deliver the material. During class, he would talk through slides, give examples, and add anecdotes. In this model, students are a mostly passive audience. They are expected to take notes, and hopefully, answer the occasional question posed by the professor. Students are then assigned work outside of class, which is graded as a summative assessment to measure if students meet the course objectives.

While lectures allow faculty to present a lot of information in a shorter amount of time, give more control over how the information is delivered and can be very well organized, these instructor-centered instructional approaches can leave students feeling bored, being less involved in the learning process, and allow fewer opportunities to assess deeper student comprehension. Superficial learning can result from an instructional experience that focuses on the instructor, whereas student-centered approaches have been found to foster a deeper understanding of course material (Postareff et al., 2007).

ENTER, BRAIN-BASED LEARNING

With Abraham looking to redesign his course, Hanifin introduced him to "brain-based learning" to create meaningful and transferable learning experiences in a movement-based curriculum.

Brain-based learning is a student-centered approach that aims to explain how neural pathways are developed based on experiences (Hebb, 1949). As certain connections are used more frequently, they become stronger and faster (Ferguson, n.d.). In the early 1980s, this approach was further developed to suggest that teaching in a "brain-compatible" way is meaningful but that much of the design of the education system goes against doing so (Hart, 1983). Brain-based learning gained momentum again in the mid-1990s with principles that help "conceptualize teaching by taking us out of traditional frames of reference and guiding us in defining and selecting appropriate programs and methodologies" (Caine & Caine,1990, p. 66). Since then, others, including Dr.

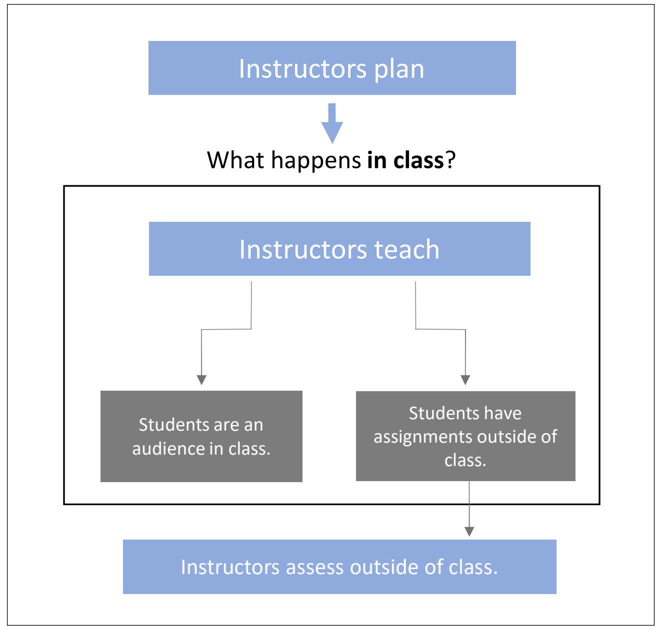

FIGURE 1. Traditional course design.

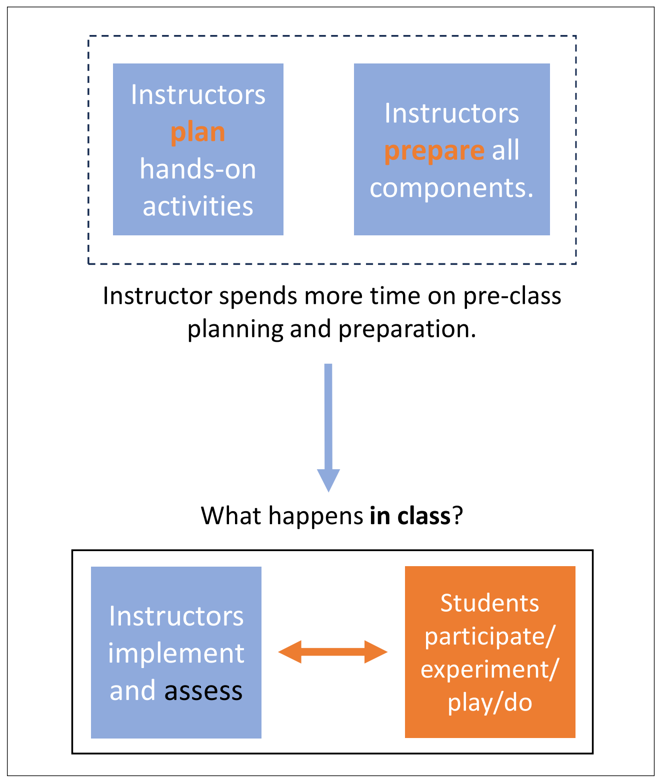

FIGURE 2. Brain-based course design.

Eric Jensen, have continued this work by applying brain-based research to teaching and learning. His approach is described as learning "in accordance with the way the brain is naturally designed to learn" (Jensen, 2000, p.6) and draws from many disciplines including chemistry, neurology, biology, and psychology. Educators are encouraged to abandon "brain antagonistic" instructor-centered practices, like lecturing. Such practices place the instructor as the information provider and the students as passive information receivers rather than focusing more on successful ways the learners' brains acquire information.

In a brain-based classroom, lessons are still planned ahead of time. This planning is typically lengthier because it requires instructors to prepare hands-on activities that will be used to facilitate learning (see Figure 2). During class, instructors implement the activities, students actively engage with the material, and the instructor guides them through instead of simply giving them the information. In this model, the learning is more student-initiated and assessment is more formative. Instructors can shift on the fly if students are not meeting the learning objectives. Outside the classroom, assignments can be given to reinforce learning or reflect on what they learned in class.

PLANNING THE REDESIGN

Before developing lessons that included brain-based learning elements, Hanifin started the process with the end in mind (Wiggins & McTighe, 2005). To create or add value to a course design or redesign, she believes the process begins best with brainstorming, prioritizing, and questioning. First, the instructor identifies all concepts he or she wants students to take away from the course. These concepts are formed into preliminary questions that, with refinement, guide instructional choices to become essential questions. For Abraham's biomechanics course, three original essential questions were developed (see Table 1, left column). The resultant conversation between the colleagues sparked the revision of the first and third essential questions so each one scaled to higher level thinking and reflected answerable questions for his students (see Table 1, right column).

In contrast to the deliberately reductive process of formulating essential questions, the next step in the design collaboration is a purposely extensive brainstorming and prioritization exercise known as a "50-30-20."

The 50-30-20 process requires the instructor to lay out the components of their course in front of them (see Figure 3). Hanifin believes this process works best with physical manipulatives and large table space. An instructor, with the help of the designer, identifies every single topic in a course, which is usually driven by a textbook's table of contents. These topics, written on index cards and placed on the table, illustrate a growing chaotic display of a course's content. There is no organizational element at play yet; the instructor must see what the course looks like in this form.

The designer then asks the instructor to begin prioritizing all the information on the table. It's common for an instructor to feel that all topics on the table are important but they are not prioritized for optimal learning. Hanifin will ask, "If I were a student in this class, and we ran into each other a year after I completed your course, what would you hope I would remember?" Even at this early stage of redesign, an instructor must make critical decisions that are based on the goals he or she is now selecting for students.

ORIGINAL ESSENTIAL QUESTIONS	REVISED ESSENTIAL QUESTIONS
How do we analyze movement?	What are the biomechanical principles that act upon the body?
How do the skeletal and muscular systems interact to produce movement?	No revision was necessary.
How do we implement biomechanical analysis into practice?	How do we apply biomechanical principles to analyze human movements?

TABLE 1. Course essential questions.

FIGURE 3. Laying out components of the course content.

A 50-30-20 is a process of prioritization where all topics receive a designation of either a "50," a "30," or a "20" (see Figure 4). A "50" represents a core topic without which the course cannot exist. These are vitally important topics, and an instructor should be spending approximately 50% of teaching time on them. Once the core concepts are prioritized, the

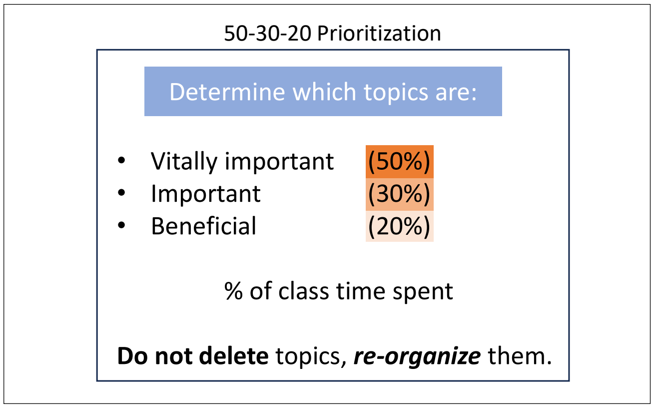

FIGURE 4. 50-30-20 Prioritization.

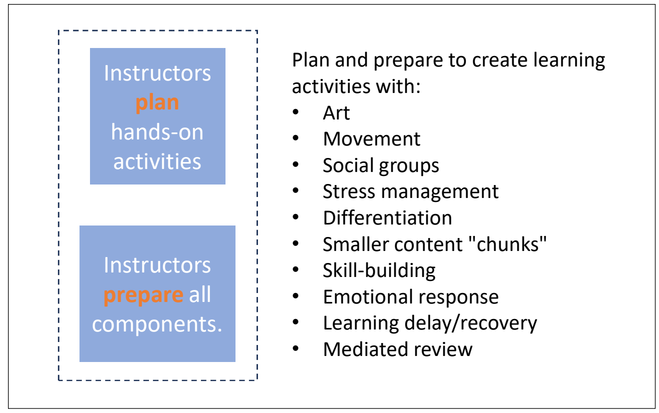

FIGURE 5. Jensen's brain-based strategies.

INNING	ESSENTIAL QUESTION	FORMATIVE QUESTIONS
1	What are the biomechanical principles that act upon the body?	• How do throwing techniques vary from person to person? • What things are happening to the rest of the body during a throw?
2	How do the skeletal and muscular systems interact to produce movement?	• What motions are you looking at during this movement? • What muscles are we using during a hitting motion?
3	How do we apply biomechanical principles to analyze human movements?	• What muscles are most active? • How are the muscles and bones interacting during a running motion?

TABLE 2. Formative question development based on the course's essential questions.

remaining topics are labeled a "30" or a "20." Some 30s and 20s support the existing 50s and fall within the same broader category. Some 30s become their own topics, important to the core, but are prioritized differently for design decisions. Like the 50s, the 30 and 20 labels also indicate the respective percentage of class time devoted to that material.

FROM PLANNING TO PLAYING

After prioritizing the course material, Hanifin and Abraham continued their collaboration to create a series of learning experiences that tied the course's essential questions to the 50-30-20 prioritization. These brain-based strategies/tools (Jensen, n.d.; see Figure 5) contained elements to better mimic our brain's natural curiosity and propensity for knowledge acquisition, moving students out of passive lectures and into small groups with targeted course content and hands-on activities. Abraham felt intrigued by this approach, knowing this was in direct contrast to lecture-led teaching. Planning these activities required creativity and involved risk because the instructor did not necessarily know if the students would arrive at the answers they needed. Though it required the instructor to give up control of the learning process, it freed him up during class time to *witness* the learning and guide it more personally based on what he was observing in the small cooperative student groups.

Introducing the Essential Questions

Abraham's first class of the semester introduced all three essential questions using a simple three-inning wiffle ball game. Hanifin suggested playing wiffle ball to introduce the essential questions because of Abraham's background in sports medicine, having worked with baseball players for 12 years, and the game's movement qualities. It's important in this design case to note the inherent discomfort and sense of risk at play for Abraham when committing to a game, rather than a well-formed lecture, to introduce his learners to the semester's pursuits. Hanifin understands the fundamental role of trust at play in a true course design collaboration.

Formative questions, based on a certain movement, were developed using the essential questions as a guide. Unlike essential questions, which Hanifin prefers to limit to one, formative questions are not limited in number. The formative questions allowed the students to make more targeted observations during each inning (see Table 2). Inning one focused on throwing, inning two focused on hitting, and inning three focused on running. At the end of the game, Abraham gathered the students for a large group discussion to elicit their observations and discuss how each answer was connected to the essential question. While the game was a relative success, by the end of debriefing all three movements at the same time, the students had less detailed examples and answers to the questions. For future iterations of the learning activity, Abraham made notes to use small group discussion instead of larger group discussion and have students debrief on each movement at the end of each inning instead of discussing all three at once.

FIGURE 6. Students use art to illustrate standard reference terminology.

Connecting Other Lessons to Each Essential Question

Nearly every week, Abraham and Hanifin met to reflect on what worked and, often more importantly, what did not. This information was then used to develop future brain-based lessons. When developing these and other lessons, Hanifin's design decisions are always rooted in the engagement of new learning. She knows from years of teaching and designing that the human brain responds well to puzzles, a movement that is not overly serious, and memory made by rhyme, rhythm, or stories. There is a child-like element to these choices because Hanifin feels our inner child is the ideal learner of something new, especially in an undergraduate course like this.

FIGURE 7. Group of students discussing a "bag of chaos" puzzle.

One lesson focused on students discovering pertinent information on standard reference terminology to describe joint motion. This information was vital to answer the first essential question, "What are the biomechanical principles that act upon the body?" Students developed colorful, poster cheat sheets or mnemonics (see Figure 6) to describe four assigned categories:

- Anatomical reference position (erect standing position with all body parts facing forward).
- Directional terms such as superior, inferior, medial, lateral, anterior, and posterior.
- The sagittal, frontal, and transverse cardinal movement planes.
- Longitudinal, anteroposterior, and mediolateral axes of motion.

Once the group was ready, and using their artifact, students shared (peer-taught) their concept with the rest of the class. The instructor was then free to address incomplete or inaccurate information as needed.

Later in the semester, another lesson used a sort of puzzle, or "bag of chaos," approach (see Figures 7 and 8) to discover how joints are classified and how the associated skeletal structures interact to produce movement (essential question #2). A "bag of chaos" is a matching exercise where students

FIGURE 8. Group of students discussing a "bag of chaos" puzzle.

are given both the problem and the solution but must align them using available resources (textbook, internet, etc.) and discussion amongst group members. In this lesson, the class was broken into two groups that were given identical bags with diagrams and definitions in no order. Each group had to match the joint class diagram with its correct definition using the course text or the internet. Once both teams had what they thought were the correct answers, the class was brought back together to discuss and confirm, or correct, student choices.

Toward the end of the semester, a lesson was developed where students were asked to pair up and create a "goofy dance move." Fun and exaggerated moves were encouraged. Once the students had their moves down, the partner provided a detailed written analysis of the structures and movements of an assigned joint without using books, phones, or other references. Finally, each pair displayed their move and a verbal analysis in front of the class. These reports allowed Abraham to assess how well students were able to answer essential question #3: "How do we apply biomechanical principles to analyze human movements?"

REFLECTING ON THE PROCESS

While students seemed to embrace the increase in hands-on learning, some were not used to this atypical approach causing them to want to revert to a more comfortable, mostly passive, instructor-centered lecture style. Based on an anonymous feedback survey given at midterm, students revealed both positive and negative reactions to the brain-based approach.

Students responded positively to having "real-life connections to the concepts in the textbook" noting that the visual and hands-on learning activities "help put them into perspective." One student commented that "(the way we learned the content) created an interest in the activity rather than reading it from a boring book." On the other hand, some student responses indicated what they thought was missing in this alternate method of instruction, specifically asking for "more detailed notes," "specific definitions," and "follow the textbook." One student offered, "I feel like we bounce around a lot."

Brain-based learning environments create a larger number of mistakes than any educator is trained to be comfortable with inside their classrooms. It's not surprising though, as the American educational culture emphasizes reinforcement of correct answers and set procedures while typically avoiding or ignoring mistakes or incorrect responses. Mistake-making is not necessarily to be avoided, it may play a beneficial role in the learner's memory, engagement, attention, and the teacher's subsequent support and focus. Making mistakes "may be worthwhile to allow and even encourage students to commit and correct errors while they are in low-stakes learning situations rather than to assiduously avoid errors at all costs" (Metcalfe 2017, p. 465). Abraham found that his students became far more comfortable making mistakes within the lesson activities than on other graded items of the course.

Abraham's teaching evolution manifests as much learning for him as that of his students. The juxtaposition of mistake-making and problem-solving inside his biomechanics classroom mirrored the course redesign process that took place before and after these classes. This semester-long cooperative process represents the formative assessment necessary to transform one's teaching, the cyclical process of design (Jonassen, 2008).

Abraham discovered that:

- Brain-based design requires a great deal more planning time.
- Brain-based design benefits from student buy-in to the approach.
- Brain-based design lends itself to far more mistake-making than an instructor-led lecture.

Planning time, student buy-in, and mistake-making may seem, at first, like detractors to adopting a brain-based instructional approach. A closer look, however, reveals its benefits.

While lectures dominate higher education classrooms, college instructors rank hands-on activities as far more effective (Smith & Valentine, 2012). The more extensive time needed for planning means class time is leveraged by listening to the students work together through their cognitive processing. The instructor is free to collect the questions, comments, and understandings of the class as they occur, and free to interrupt, correct, emphasize, or re-direct as needed. Abraham's active, student-centered class time allowed him to gather useful information about the course content, specifically what comes more easily to the students, what confuses them, and where he should mediate.

Abraham's instructional approach shifted significantly because of the design collaboration. Once he became comfortable with managing a highly active and interactive classroom, he was able to reconcile where and when direct instruction benefits the learning in his classroom.

FIGURE 9. Using the wiffle ball game in a different course.

HOW ONE COURSE REDESIGN INFLUENCED ANOTHER

Following the brain-based biomechanics course redesign, Abraham was assigned to teach a kinesiology course. He did not approach the course merely with a text, a table of contents, and some lecture slides, though they still play a role in his classroom. Instead, he knew to use those foundations to craft essential questions, prioritize content, and design hands-on learning experiences aligned to help students discover answers. In a unit exploring basic biomechanical concepts, Abraham had the opportunity to revive and improve the original wiffle ball game that he used to start his brain-based learning journey.

In this iteration, after each at-bat in this now 5-inning game (see Figure 9), teammates discussed and documented examples of:

1. Newton's three laws of motion.
2. Tensile and compressive forces.
3. Torque, including a free-body diagram illustrating the associated forces.
4. The relationship between balance, stability, and motion.
5. The three classes of levers, including a free-body diagram of the associated forces.

Using formative questions he developed similarly to those in his biomechanics course, Abraham was able to witness students using the vocabulary (Newton's laws of motion, types of forces, etc.), recall prior biomechanical knowledge, debate the correctness of each other's observations, and once the small groups came to a consensus, provide evidence to support their answers.

The original wiffle ball lesson took place at the beginning of Abraham's and Hanifin's initial course redesign, and its purpose was singular: to introduce the students at a broad level to the course's essential questions. The kinesiology course wiffle ball game was used as a learning experience that would act as a "hook" to get the students interested in the topic as well as serve as a valuable point of reference during direct instruction later in the semester.

CONCLUSION

Instructors and instructional designers at all levels may grapple with the evolving landscape of what we know of learning as it relates to how we spend class time. While this designer's methods require spending a greater amount of time in creative instructional planning, encouraging, and defending the subsequent student-centered activities, and fostering an environment that welcomes mistake-making, brain-based learning opened up this professor's instruction to many possibilities. The brain-based instruction that drove both the design choices and collaboration drew Abraham into the same experience as the learner—discomfort, discovery, and change. Abraham's collaboration with an instructional designer and his experience with the planning and implementation of brain-based instruction have also influenced his broader instructional approach to now regularly include student-centered learning strategies in all the courses he teaches.

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