

SQL COURSE DEVELOPMENT  
VIA SCAFFOLDING, SOCIAL CONSTRUCTIVISM,  
& FANTASY FOOTBALL

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CERTIFICATE OF APPROVAL

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## Abstract

Applying scaffolding and social constructivist concepts in online learning environments requires consideration of multimedia design and the impact it has on learning achievement. Online learning is transforming students' experiences from "learning from technology" to "learning with technology". Social constructivism –theoretical model in which learners make meaning from experience – and scaffold –theoretical guidelines for learning through incremental assistance – approaches aid instructors in providing effective and responsible learning environments though balancing student support and engaging challenges to help students understand that, ultimately, they learn from and teach each other.

This project seeks to execute scaffolding and social constructivist techniques in a prototype online undergraduate level course on Structured Query Language, a programming language, for computer science and related field students. The prototype focuses on utilizing datasets from professional football players and utilizing Gamification aspects to create a pseudo fantasy football league. Students manage their fantasy teams and compete via increasing difficult SQL statements.

## Acknowledgement

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I owe gratitude to Eleanor Cirelli, a recent passed mentor and friend from the campus, who has shown support for my academics and wellbeing since 2007. Without her support all those years I doubt this project would have materialized.

This thesis project is being used to further explore teaching styles and learning methodologies for my own goals. I am using this project to help develop my own teaching style with the intent of applying for adjunct positions upon graduation.

## Table of Contents

Abstract.....	3
Acknowledgement .....	4
Project Introduction .....	7
Research Questions.....	7
Goal.....	8
Method.....	8
Literature Review.....	11
Social Constructivism and Scaffold Defined.....	11
Knowledge Creation via Scaffolds and Social Constructivism .....	11
Style & Technique .....	12
Gamification & Scaffolding – Increasing Engagement .....	14
Literature Review Conclusion .....	14
Project Background.....	15
Moodle .....	15
Videos .....	15
Fantasy Football.....	16
Project Implementation.....	16
Moodle Course Shell.....	16
Podcasts.....	19
Databases .....	20
Supplemental Materials.....	21
Fantasy Football Becomes an SQL Learning Environment.....	21
Conclusion .....	24
Bibliography: .....	26



## Project Introduction

The hypotheses and/or ideas pertaining to instructional scaffolding teachers articulate within an online course to students vary greatly from instructor to instructor. Understanding how, and why, online educators choose and employ certain techniques over others is key when an educator begins creating a college-level online course. Determining whether or not the application of social constructivist educational principles, such as level of direct instruction and attention to group dynamics, play a significant role in a student's motivation, participation, and overall grade is fundamental when establishing a teaching style and syllabi. It is also important to understand how social constructivist principles and scaffolding play into a class's social culture and if scaffolding techniques affect the teacher-to-student relationship as well as the student-to-student relationship.

## Research Questions

The research questions which define this thesis are as follows;

Primary:

- What hypotheses and/or ideas about instructional scaffolding do teachers articulate within an online course to students?

Secondary:

- How do teachers enact scaffolding within a course that is both supportive and reflective of the teacher-to-student and student-to-student relationships?
- Does the application of social constructivist educational principles, such as level of direct instruction and attention to group dynamics, play a significant role in a student's

motivation, participation in the learning experience, and success at reaching associated learning outcomes?

- How can scaffolding affect a class's social culture?

## **Goal**

The goal of this study is to explore the application of social constructivist theory and scaffolding techniques in a real world setting for teaching an online undergraduate course in computer programming. The programming language I have chosen for this project is SQL or Structured Query Language. The increased reliance on the structured query language (SQL) as the main query language for databases – SQL is the industry standard database query language per the American National Standards Institute – means that it is becoming increasingly important for educators to explore way to teach such a topic effectively.

## **Method**

The literature review accompanying this study confirms scaffolding techniques have been proven by many empirical studies; that as learning aids fade so as to transfer the learning responsibility from the teacher to the learner a deep understanding of a topic is achieved and knowledge creation is facilitated. These practices may be executed in an online undergraduate environment as follows:

*Table 1: Scaffolding Elements from Hogan & Pressley (1997).*

Scaffolding Element	Description
Pre-engagement	Instructor selects an appropriate task by anticipating student challenges and needs by considering curriculum goals.
Establishing a shared goal	Motivation as a crucial component for success - students' ownership of goals is imperative
Diagnosing the needs of learners	Needs a knowledge of content and a sensitivity to the learners' current knowledge
Provide tailored assistance	Assistance in the forms of: questioning, cueing, prompting, coaching, modeling ideal performance, direct instruction, discussion.
Maintaining the pursuit of the goal	Uphold the concentration on a task by requesting clarification, asking questions, offering praise.
Giving feedback	Progress summaries, pointing out ideal behaviors, comparing with the ideal, explicitly restating the concept behind a task.
Controlling frustration and risk	Creating a "safe" environment where mistakes are appreciated as part of the learning process.
Assisting internalization, independence, and generalization to other contexts	Assisting students to become less dependent on the instructor.

Below illustrates a series of steps for the online learning model – ESCIE – which provides a flow of learning that can continue indefinitely but ultimately will come to a formal end with the culmination of a course component or semester from Bryceson (2007).

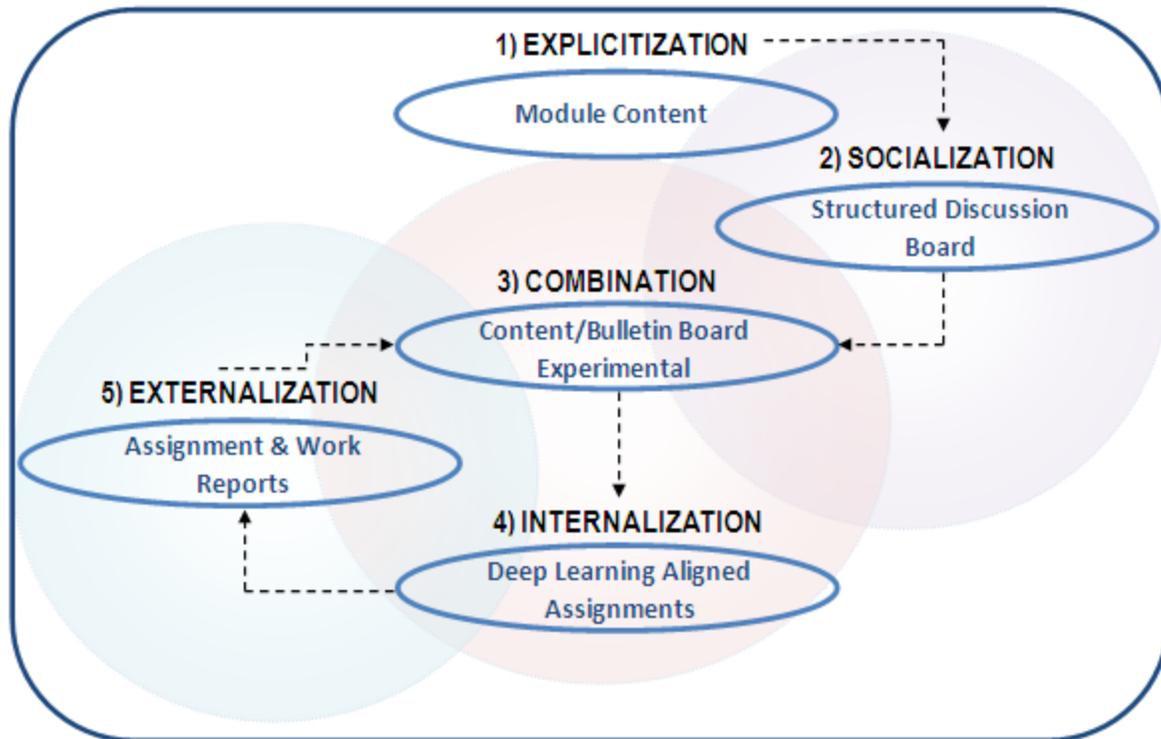


Figure 1: ESCIE Model created from Bryson (2007) Material.

## **Literature Review**

Scholarly articles and case studies were reviewed which focus on teachers and students exercising a social constructivist approach to learning. Additional articles were analyzed with a focus on scaffolding techniques and how these methods compared to other traditional learning methods.

## **Social Constructivism and Scaffold Defined**

Social Constructivism is a learning model that encourages students to feel responsible and in control of their gains in knowledge and understanding. Students develop knowledge in an evolving manner through interactions with others and by building connections between prior understandings and new facts. A student's range of learning potential is not only shaped by the social environment in which it takes place, instruction must also proceed developmentally via decreasing levels of instructor assistance, called scaffolding. Chen et al (2013) urge that scaffolding is characterized by social interaction that precedes the internalization of knowledge and skills deemed valuable or useful to the learner. As facilitators of knowledge discovery teachers must create supportive structures that initiate and sustain student interest to keep them involved in the learning process.

## **Knowledge Creation via Scaffolds and Social Constructivism**

Chen et al (2013) explain that scaffolding supports learners by supplying aids tailored to their evolving requirements of an educational goal. These aids will diminish – are reduced – as the learner becomes increasingly competent in their study. Scaffolding has been applied in a variety of fields, including; curriculum, instruction, and learning. Its validity has been proven by many empirical studies that as learning aids fade, so as to transfer the learning responsibility

from the teacher to the learner, deep understanding of a topic is achieved and knowledge creation is facilitated.

Dias and Diniz (2013) regard the quality of interaction between students and teacher is paramount in the quality of learning experience as a whole. It is argued that “(un)successful learning is intrinsically dependent on the degree of interaction that takes place in a specific educational context.” Learners are inclined to cite prior knowledge on a subject matter in discussions and internal knowledge creation processes. It is by interacting with peers and experts –experts can include teachers or literature – that they combine the new information presented with their prior understanding to create new knowledge.

Scaffolding is best employed in learning situations where students have opportunities to communicate their thoughts through conversations. Hogan and Pressley (1997) describe student conversations as the dialogic process by which we create and negotiate knowledge with each other. “It is the primary means for solving high-order problems and developing thinking strategies in those with less expertise... The teacher’s responsibility is the facilitation of oral and written discourse in meaningful and/or useful ways.” (p10)

### **Style & Technique**

There are multiple techniques and styles available to execute a scaffold structure. Bryceson (2007) investigates many populate mechanisms, such as; structured discussion boards, video lectures, and documents which includes hyperlinks (so students can read additional information if they want to). Socialization was a large contributor to the success of the students regardless of the mechanism used.

Choosing and blending several techniques can increase material redundancy but is recommended to accommodate varying student learning styles. In a study by Ocepek et al (2013) collegiate students were assessed individually on their learning style preferences and then presented information across different multimedia venues. It was determined that students most favored text with color discrimination and well-written text followed by video materials.

Another technique in executing a scaffold structure involves differentiated teaching. Defined by Mok (2012) as “a process to teaching and learning for students of differing abilities in the same class Formula (with the intention to) maximize each student's growth and individual success” differentiated teaching can help meet the needs of different students, stronger or weaker ones, by preparing separate sets of exercises in differing complexity. This technique allows weaker students a guided “best practices” example of how to approach an assignment while allowing stronger students to forage ahead with less guidance. Zuga et al (2005) stress that “students can benefit from multiple and dynamic ways of material presentation” and that some students may need more assistance than others grasping new concepts.

McCullagh (2012) argues that instructors should create reflection videos to supplement their curriculum, as a video “provides the opportunity to re-live a teaching episode.” While McCullagh largely stresses that video reflections should be utilized for the instructor’s personal growth it does not disregard the importance of sharing such experiences with students; video not only has potential to encourage and enrich collaboration but can also provide a means for transforming a transient personal experience into a permanent entity which can be watched whenever by whomever the teacher chooses.

## **Gamification & Scaffolding – Increasing Engagement**

Increasing a student's desire to participate in online learning environments will increase their overall learning experience. Engaging learners via reward systems, as Brunsell and Horejsi (2013) explain, such as achievement titles and leaderboards not only creates co-operative learning but also competition through intrinsic and extrinsic motivations, further discussed later. This process, known as gamification, has inherently similar properties to scaffold structures; as learners advance in skill and understanding of a topic they are expected to master more difficult subject content with less and less guidance and coaching from a teacher.

One way to employ such motivations – intrinsic and extrinsic – is to create competition among students by tying assignments to a game with leaderboards and achievement ranks. The technique of using a game model to create a meaningful learning experience is explored by Flockhart (2006) on teaching mathematics to students via fantasy football. Fantasy football is a game where people create their own “dream teams” of professional football players and use a scoring system determined by a moderator (which in no way resembles a real American Football game) for determining a winner. In this study the student's points were determined by their understanding of mathematical concepts which were applied to their chosen football players' statistics. While the audience is not collegiate level the principles of designing education content that both satisfies learners' social and cognitive needs spans across groups.

## **Literature Review Conclusion**

Social Constructivist and Scaffold concepts in online learning environments impact students' learning achievements by supporting and engaging learners to challenge and teach each other via their interactions competitively and guidance from an instructor. Scaffolding employed in an undergraduate course will require advanced planning by the instructor, such as;

determining the level of scaffolding students need and assignment guides for both more advanced students and learners who will struggle with the taught material. Motivation for understanding the material must be more than “letter grade” based; it must motivate students to increase their participation and learn cooperatively with each other to further interplay with group dynamics established by an instructor. Student-to-student interaction encourages interdependent learning and competition as it is only when we learn from each other that we are enabled to teach each other.

## **Project Background**

### **Moodle**

To implement some of the findings suggested by the literature review on social constructivism and scaffolding a prototype for an introductory SQL course was developed online using the LMS system called Moodle. Moodle – which stands for Modular Object-Oriented Dynamic Learning Environment – is a free e-learning platform which can be hosted on webserver and allows for academic needs such as; forum discussion, assignments, quizzes, wikis, and grading. Moodle can also host small databases and allow others to interface with them.

### **Videos**

Components of the literature review concluded that instructors should create videos to supplement their curriculum, as a video “provides the opportunity to re-live a teaching episode.” The importance of sharing such experiences with students not only has potential to encourage and enrich collaboration but can also provide a means for transforming a transient personal experience into a permanent entity which can be watched whenever by a student.

## **Fantasy Football**

The use of a database comprising of engaging and challenging elements is necessary in executing some of the Gamification aspects discussed in the literature review. For this project professional athletes data will be used and the students will act as managers of their own fantasy football teams.

Fantasy football is an interactive game in which teams of people compete against each other as managers of virtual teams built from real players. The players that a person is able to manage are professional football players in the National Football League (NFL). People make decisions on player drafting, trading, adding or dropping.

## **Project Implementation**

A series of podcasts and discussion forums were created to explain SQL high-level concepts. All components were placed within a Moodle course shell.

## **Moodle Course Shell**

The Moodle parent course shell (available at <http://www.codadactyl.com/moodle/>) comprises of week-long chapter child courses which cover increasingly difficult subject matter. Each child course link brings the user to another webpage.

## Course Names and Descriptions:

Table 2: Created Syllabi which follows a scaffolding design inspired from literature review

<b>My courses</b>	<b>Description</b>
Welcome to SQL course 101: Start Here!	This course provides a solid and practical foundation for the design, implementation and management of a database system. It familiarizes students through hands on experience with a relational database (MySQL) exploring its basic structures, methods of manipulation - both as an end user and a programmer utilizing a programming language and data base design.
Week1: SQL Database Concepts	This lesson will describe what a database is. There will be a short high-level podcast followed by an assignment to research database structures on your own and share with the class your findings. You are required you post to the forum and review several peer's responses.
Week2: Fantasy Football Set Up	In this lesson we will begin setting up our own Fantasy Football database shells. This database will be used throughout the entire course.

Course Site itself:

**SQL Course Development** You are logged in as [John Smith](#) ([Logout](#))  
English (en) ▾

This is a prototype for an introductory undergraduate SQL course shell.

**Main Menu** [-]  
[Level of programming experience](#)

**Calendar** [+]

### My courses

[Welcome to SQL course 101: Start Here!](#) This course provides a solid and practical foundation for the design, implementation and management of a database system. It familiarizes students through hands on experience with a relational database (MySQL) exploring its basic structures, methods of manipulation - both as an end user and a programmer utilizing a programming language and data base design.

[Week1: SQL Database Concepts](#) This lesson will describe what a database is. There will be a short high-level podcast followed by an assignment to research database structures on your own and share with the class your findings. You are required you post to the forum and review several peer's responses.

[Week2: Fantasy Football Set Up](#) In this lesson we will begin setting up our own Fantasy Football database shells. This database will be used throughout the entire course.

*Figure 2: SQL course prototype homepage created with understanding to scaffolding and social constructivism learning methodologies*

Within each of the courses there are components for lesson materials and a class forum, shown below:

The screenshot displays a web interface for a course titled "Week1: SQL Database Concepts". At the top right, it indicates the user is logged in as "John Smith" with a "Logout" link. Below the title, there is a breadcrumb trail: "sqlcourse ► DBconcepts".

The interface is organized into several sections:

- Left Sidebar:** Contains navigation links for "People", "Activities" (with sub-links for "Databases" and "Forums"), "Search Forums" (with a search input and "Go" button), "Administration", and "My courses".
- Topic outline:** A central list of items:
  - Item 1: "Week 1 Course Materials" (with a database icon) and "Database Structure Introduction" (with a database icon).
  - Item 2: "Week1 Discussion Forum" (with a forum icon).
- Latest News:** A section on the right showing a post from "24 Dec, 14:03" by "Shawna Thornton" titled "Questions on the Assignment?". It includes a "more..." link and a link to "Older topics ...".
- Recent Activity:** A section at the bottom right with a "+" icon.

At the bottom of the page, it repeats the login information: "You are logged in as John Smith (Logout)" and includes a "Home" button.

Figure 3: SQL Week1 course component module; consists of weekly course materials, a sample database, and a discussion forum.

## Podcasts

Podcasts have been created and are stored within each child course's weekly material section. These podcasts are created using Microsoft PowerPoint and TechSmith's Jing capture tool and hosted online on Screencast.com.

Each podcast is focused on a specific topic and goes through an example which is later used in another part of the lesson.

# Table Columns and Rows

- ▶ Columns are like categories
  - Each column is a specific kind of data element (example: Name, Username, Date)
- ▶ Rows consist of each data entry.
  - Each row will have the data elements which match up to the columns

Example

USER TABLE				
Column Name	full_name	usemame	id_number	create_at
Column Type	VARCHAR	VARCHAR	NUMBER (PK)	DATE
Row 1	Mike McIntosh	apple 1	01	9/20/2013
Row 2	George Gala	apple 2	02	4/3/2012
Row 3	Holly Honeycrisp	apple 3	03	11/11/2011
Row 4	Granny Smith	apple 4	04	10/30/2013
Row 5	Edward Enterprise	apple 5	05	1/1/2012
Row 6	Lily Liberty	apple 6	06	2/14/2013
Row 7	Sam Suncrip	apple 7	07	9/3/2010
Row 8	Rosie RedDelicious	apple 8	08	6/25/2013
Row 9	Luke Lodi	apple 9	09	5/9/2012
Row 10	Molly Delicious	apple 10	10	7/9/2013
Row 11	Paula Red	apple 11	11	12/24/2012
Row 12	Chris Cortland	apple 12	12	8/9/2013

Figure 4: A sample slide from the Week1 podcast on SQL high-level concepts illustrating a table which is used in an assigned exercise.

## Databases

In this course students create and maintain databases. As each podcast illustrates a SQL lesson students are expected to emulate and surpass the shown material in a database either in their own database or in a provided database shell within the Moodle site.

Databases in Moodle are created for students to collectively populate, data is shown onscreen and students can create, edit, and drop entries:



Figure 5: A screenshot of the GUI database from the Week1 assignment, which mirrors the table shown in Figure 4

### Supplemental Materials

Material redundancy accommodates varying student learning styles – helps students who struggle with the lesson material and style while allowing stronger students the option to skip unneeded extra exercises. These supplemental areas include written “tips” and podcasts of example walkthroughs on particularly important areas to pay attention to within assignment text.

### Fantasy Football Becomes an SQL Learning Environment

Fantasy football is an interactive competition where a group of people compete against each other as managers of virtual teams built from real players. The players that a person is able to manage are professional football players in the National Football League (NFL). People make decisions on player drafting, trading, adding or dropping. Players are enthralled in a game of statistics, much like an SQL database analyst profession. Players of the game collect points based on how many touchdowns and yards are scored in real games for their virtual teams made up of football players from all NFL leagues. In this course prototype students keep track of the scores

via SQL statements, create their own teams, and compete against each other in Head-to-Head Leagues.

A Head-to-Head League consists of a two team match-up each week. Students are paired against each other in the class into two player contests. The player who receives the most points in the competition week “wins” the match. The scoring system is decided by a custom set of rules set up by the instructor, as the acting League’s commissioner. The scoring system is derived from that week’s SQL lecture topic and the win/loss outcome does not affect student’s grades.

Example from Moodle Course:

During a lesson on SQL WHERE clauses and Wildcards a match up for the week’s “win” for one Head-to-Head team could be determined by the following statement; Sum the total number of players with a ‘J’ or a ‘W’ in their name for the game week of September 29<sup>th</sup>.

# Scoring System Example

- ▶ MATCH UP WEEK Q FOR THE WIN:

*Sum the total number of players with a 'J' or a 'W' in their name for the game week of September 29<sup>th</sup>*

- ▶ Break down shown below

Sample Player Table					
Column#	Player Name	Did he play that week?	Does he have a "J" or "W" in name?	Does he count for my score?	Rowcount
1	Sebastian Janikowski	Yes	Yes	Yes	1
2	Colin Kaepernick	Yes	No	No	1
3	T.J. Yates	No	Yes	No	1
4	Reggie Wayne	Yes	Yes	Yes	1

```
SELECT SUM(Rowcount) FROM SamplePlayerTable WHERE  
(PlayerName LIKE '%J%' OR PlayerName LIKE '%W%') AND  
DidHePlayThatWeek = 'Yes';
```

Figure 5: A sample slide from the Week2 podcast on assignment examples

Students are expected to write their own code to determine their “score” and post that number to the forums. That number shows that they 1) completed the assignment, 2) provides an easy way to grade students quickly, 3) identifies students who need additional help if their number is incorrect, and 4) creates a learning environment with has extrinsic motivations via friendly competition to emulate stronger ones. It also has outstanding potential to increase student interaction as others will have an open opportunity to help their peers without being able to give them the direct answer – as no two students should ever have the same answer. Assessments are based on a student’s ability to produce the correct SQL statement to achieve the appropriate answer for their team’s score. Quizzes will be used to gauge the

level of course content in order to adjust accordingly, speed up or slow down, to the overall class pace and gain insight for creating additional supplemental materials.

## Conclusion

Online learning environments must be engaging and challenging in order to fully immerse a student into academic material. Creating a course that encourages students to feel responsible and in control of their own learning potential encourages them to develop a deeper understanding of a subject. One effective method of accomplishing this goal is via interacting and challenging their peers – an intrinsic motivator to help and surpass others. Inspiring critical thinking skills through collaboration between students is fundamental to learning and mastering a new skillset – an extrinsic motivator.

As teachers we must become the facilitators of knowledge discovery instead of the gatekeepers of it. By creating supportive structures that initiate and sustain student interest we can keep them involved in the learning process; as a student's desire to participate in learning environments increases their overall education experience. Instructors cannot disregard the importance of sharing challenging, failing, or successful experiences that students encounter as these victories, or losses, for them may encourage and enrich collaboration among them.

Developing proper scaffolding structures for a course takes a lot of preparation by the instructor but ultimately invokes a deeper understanding of the taught material. It more accurately simulates a real world, occupation, experience for students where employees engage in a brief orientation period and then are expected to hit the ground running; to be ready to work immediately on a new challenges with limited support. Milestones can be marked with quizzes with determine if students are comfortable with the pace of the course which will allow the instructor notice to create additional supportive structures.

Differentiated teaching methods are necessary to accommodate varying learning style in students. Students are not alike, they do not progress at the same pace despite their potential, and it is the instructor's responsibility to create a diversified learning package of material by supplying aids tailored to

the evolving requirements of an educational goal for stronger and weak ones alike. This can be accomplished by instructor created materials which show optional “best practices” examples of lecture material.

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