# TEACHING THE ENTREPRENEURIAL MINDSET IN DATABASE CLASS

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***Abstract**:* The purpose of this paper is to present a technique for teaching entrepreneurial mindset to students in database class. The practical implementation of the technique is discussed. Results of applying the technique are presented.

***Keywords**: Entrepreneurial Mindset, Entrepreneurial Understanding, Teaching Techniques, Databases, Education, Project-Based Learning, Team-Based Learning*

***ACM Classification Keywords**: K.3.2 Computer and Information Science Education*

## INTRODUCTION

According to the Webster dictionary entrepreneurial means: 1. of or pertaining to an entrepreneur or entrepreneurship; as, entrepreneurial risks; 2. Willing to undertake a project requiring initiative and involving risk, for one's own purposes, - of people; mindset means a habitual or characteristic mental attitude that determines how you will interpret and respond to situations. Entrepreneurial mindset refers to a specific state of mind, which orientates human conduct towards entrepreneurial activities and outcomes. Individuals with entrepreneurial mindsets are often drawn to opportunities, innovation and a new value creation. Characteristics include an ability to take calculated risks and accept the realities of change and uncertainty [1].

In the United States the process of introducing entrepreneurial training at colleges and universities started in the seventies of the 20th century. It is estimated that currently more than 80% of all U.S. colleges and universities implement such programs. According to the 2013 report of U.S. Department of Commerce "The Innovative and Entrepreneurial University: Higher Education, Innovation & Entrepreneurship in Focus": "Colleges and universities are investing heavily in the development of their students' entrepreneurial skills. While many students dream of starting the next Facebook® or Twitter® (both of which were started by students), universities are more focused on the pedagogical value of entrepreneurship as a set of skills that can be applied across professional environments and activities to supplement students' classroom experience. Universities are investing both in formal programs as well as in extra-curricular activities to channel students' interest in solving global problems through entrepreneurship." [2].

Thinking about 'entrepreneurship teaching as a toolbox' is a fundamental feature for educators, because these tools may help in improving the way we are currently teaching entrepreneurship in universities, as well as enable students practicing entrepreneurial skills through creative thinking and reflection [3]. An entrepreneurship educator can help students develop entrepreneurial skills such as: entrepreneurial thinking, creativity and innovation, learning from failure, and reflection [4].

Kettering University participates in the initiative to develop the Kern Entrepreneurship Education Network (KEEN) (http://keennetwork.org/). The goal of KEEN is to make entrepreneurship education opportunities widely available at institutions of higher learning, and to instill an action-oriented entrepreneurial mindset in engineering, science, and technical undergraduates. KEEN specifically outlined seven student outcomes pertaining to the entrepreneurial mindset. A student should be able to:

1. Effectively collaborate in a team setting (teamwork)

2. Apply critical and creative thinking to ambiguous problems (problem solving)

3. Construct and effectively communicate a customer-appropriate value proposition (customer awareness)

4. Persist through and learn from failure to learn what is needed to succeed (persistence)

5. Effectively manage projects and apply the commercialization process within respective disciplines (project management)

6. Demonstrate voluntary social responsibility (social responsibility)

7. Relate personal liberties and free enterprise to entrepreneurship (free enterprise).

## THE METHODOLOGY

The developed methodology is based on Project-Based Learning (PBL) and Team-Based Learning (TBL). Project-based learning is a dynamic classroom approach in which students actively explore real-world problems and challenges and acquire a deeper knowledge [5]. Project-based learning is often portrayed as an alternative to passive learning and rote memorization. If traditional education is classical, PBL is jazz. In a PBL classroom, teachers present problems that students must solve together in groups [6]. TBL is powerful and versatile teaching strategy that enables teachers to take small group learning to a whole new level of effectiveness (http://www.teambasedlearning.org/).
In our approach the students also select the problems. The methodology proposes to teach students about acquiring entrepreneurial skills through development of a new database system. We choose the lab hours in CS461: "Database Systems" class to perform this methodology. Students came up with their own ideas for developing database systems to help Kettering University students and they follow entrepreneurship steps to design, develop and implement the system in industrial settings. The outputs of the applying the methodology are database systems, with the documentations, which are proposed to be included in the Kettering University web portal.
The technology goals are: first to learn better the objectives of the course, second to implement their own ideas following all necessary steps, third to turn the project into real marketing product. Following these steps the students are competent to tell their new-product story in business terms. They are prepared to negotiate organizational management obstacles by effectively collaborating in a team setting. They effectively manage their projects and think to apply the commercialization process.
Working on the project gives students the ability to recognize opportunities that have a technical solution. They construct and effectively communicate a customer-appropriate value proposition. They are able to apply critical and creative thinking to solve ambiguous problems, ability to recognize an unmet need and to act on an opportunity, creating and delivering new customer value.
The course include knowledge for database system design and implementation, entity-relationship model, relational model, object-oriented model, logical rules, relational algebra and calculus, relational query languages, physical data organization, design theory for databases, distributed and web-based databases.
Each student who receives credit for CS461 demonstrated the ability to do all of the following Course learning objectives:

- Use a model to design a database system from user specifications.
- Analyze memory accesses utilizing various physical storage mechanisms.
- Write queries in SQL.
- Normalize a database system.
- Implement a simple database system

Students also fulfill Entrepreneurial Mindset objectives:

- **The opportunity to**: define a project; to investing the market: analyzing similar solutions; to create preliminary model; developing functional product
- **The possibility for problem defining:** they will define the project by themselves; formulate the project solution; define how to evaluate the project outcome in terms of technical feasibility, customer value, societal benefits, economic viability;

- **Ability to design and system engineering of a product:** they will validate the market interest of the developed product
- **Communicate an engineering solution in economic and societal benefits terms:** Students will establish communication with different groups for solving the project problems
- **Develop collaborative methods:** the students are working in groups
- **Creating project management, software engineering, business and marketing skills**

As a result of developing their projects students are better prepare also for Entrepreneurial Mindset outcome:

1. **Productive Collaboration**. In the first week students are studying the Kettering University needs. They are building an effective and mission-oriented team in the week two.
2. **Resolute Integrity.** Working on the project students are allowed to identify their personal passions and start a to plan for professional development for developing database system
3. **Illuminating Communication**. Every week oral and written presentation allow presenting their solutions in technical and economic terms
4. **Multidimensional Problem Solving**. Working on the project students are allowed to apply creative thinking to ambiguous problems
5. **Enterprising Attitude**. Working on the project in many cases students made failures, starting with some technology, which did give them the best solution. Learn from failure they are finding new more effective solution.

In table 1 the goals and activities during each week are described.

**Table 1. Methodology goals and activities**

| | GOALS | ACTIVITIES |
|---|---|---|
| **`Week 1** | Presenting the project process | The instructor present the project process, the NABC (Need, Approach, Benefit, Competition) approach and ask every student to define 1 page in NABC about the project that he/she proposed |
| **Week 2** | Presenting the students project ideas | Every student presents his/her ideas as NABC. There will be a discussion. As a result groups with similar ideas are created. |
| **Week 3** | Presenting the group project ideas | Every group presents the group idea as NABC. There will be a discussion. As a result the final NABC for every group is formulated |
| **Week 4** | Presenting the similar solution | Every group present similar solution and why their solution is different from existing. There will be a discussion. As a result a text is prepare outlined the main differences in the proposed project |
| **Week 5** | Presenting tools for solving the solution | Every group presents the tools needed for solving the problem. There will be a discussion. As a result the main tools are chosen and text is prepare describing the main tools which will be used. |
| **Week 6** | Presenting a detail functional and interface schema | Every group presents detail functional and interface schema of the project. There will be a discussion. As a result the functional and interface schema are approved and text is prepare describing the architecture of the project, functionality and interface and work plan into 2 steps. |

| | | |
|---|---|---|
| **Week 7** | Step 1 | Every group demonstrated the first realized step. There will be a discussion. As a result some of the solutions can be improved |
| **Week 8** | Step 2 | Every group demonstrated the second realized step. There will be a discussion. As a result some of the solutions can be improved |
| **Week 9** | Presenting the prototype | Every group demonstrated the developed prototype. There will be a discussion. As a result some of the solutions can be improved and text with technical specification, end user manual are generated. |
| **Week 10** | Demonstration of the project in front of the University community and guests | Every group presents the project. A CD with project code, project description and presentation slides are the output of the project. Discussions about project value and project marketing are taken. |

## IMPLEMENTATION

The proposed technique was implemented twice in winter and spring terms in 2015. Students were given Database system, Product Planning and Development, Identifying Customer Needs, Business plan and Marketing plan handouts. During the Winter 2015 term the following projects were realized.

**Student Life and Greek Life Database System**

The database system is designed for use of Student Life and Greek Life at Kettering University. It is specifically designed to assist the Greek Life Coordinator and those involved in clubs on campus. It also has another potential target audience of students who want to know about the college clubs, when they have events, etc. The database system is currently structured to have tables for students, organizations, events and other relational tables like members. The data is currently stored as a MySQL database and also an independent application to access, modify, and delete entries in the database are design. The application allows users to view the data in the database in a convenient manner and allows users to modify and save data back to the database. They are functionality to support querying and filtering the database in order to obtain pertinent information. For example the Greek Life Coordinator could filter for all the members of a Fraternity that have the position of Philanthropy Chair to send an email to them. The system allows the Student Life office to obtain a copy of the application and utilize a centralized Kettering database to keep track of members of organizations. In the future this system could be expanded to allow the database system to keep track of attendance at events (maybe by members scanning their student ID) and also to give access to students with view-only permissions to query the database (to see what clubs meet on Monday evenings, who's part of Dance Club, etc.).

**Student Utilities Database System**

The purpose of the database systems is to connect students to their co-op companies so that other students can look for employers more easily, and companies can look for students. Another use for the database system is to keep track of the faculty advisors of each student for quick lookup. Finally, the student database system is used to keep track of the courses a student has and is taking, as it relates to the course databases. This database system enables students to view an abundance of housing alternatives to use as opposed to using the dorms. A web app is used to provide students to login, post information about available housing options so that students are able to access the information

at any time. The system enables students to post off campus housing locations.

**WKUF on Demand and Song Request**

The system is broken into two parts: on demand radio and song request. The on demand radio feature allows DJs to upload their shows to the website so anyone can listen to the show at any time. Another page handles all the uploaded shows. The user can sort the shows by the DJ's name and when the show aired. In addition, there is an imbedded player in the page so you can listen to the desired shows. This allows anyone to listen to a past show whenever they want. Currently there is no convenient way to request a song for a show. DJ's usually take request from Facebook or other social media platforms. This is not an ideal way because it requires someone to know the phone number for the station or know the DJ on Facebook. Therefore, being able to request songs online would be a big improvement for both the DJs and the people who wish to request a song to be played on air for them. The song request feature of the website allows listeners to fill out a form for a song they wish to be played. DJ's can then look at another page, which displays the requested songs. All these features are placed on WKUF's website for easy access by DJs and Listeners.

**Internet-Connected Coffee Maker**

The purpose of this project was to demonstrate how common household appliances connected to an Internet of Things could be monitored and controlled remotely from a mobile device. While the project's application focused specifically on creating a connected coffee maker, it presents a framework by which a mobile device, connected appliance, and back-end server can be used to control a variety of household appliances. By adding a microcomputer (Raspberry Pi) to an ordinary coffee maker (Mr. Coffee CG-12) the coffee makers ON/OFF switch were able to actuate electronically via a relay board connected to one of the RPi's general purpose input output (GPIO) pins. The RPI's built-in Ethernet connection allowed creating a Python Web Socket client program to send status updates and receive commands. A Node.js Web Socket server acts as an intermediary between mobile device clients and the coffee maker client. The server forwards status information from the coffee maker to the appropriate mobile devices and commands from the mobile device to the coffee maker. Messages between the coffee maker and mobile device use a JSON-based schema. In addition, a database (MongoDB) is used to cache status information from the coffee maker.

**Proposal Database System**

The idea for the proposal database system is simple. It's a list of proposals that users can submit, comment on or vote on. This can be applied to many different situations but the one in mind for this project was centered on collecting ideas from Kettering students and faculty about improvements to the school, or how to spend available funds.

## RESULTS

By the end of the term the students made presentation in front of faculty and administration. The **Vice President of Instructional, Administrative, and Information Technology, the Director of Sponsored Research, the Director of the Center for Excellence in Teaching & Learning also participated.** Students are asked by the finishing the project to answer several questions and give some comments about them. They put their answers in a scale from 1 to 5, where 1 means 0 %, 2 – 25 %, 3 – 50 %, 4 – 75%, 5 – 100%. The % in the following tables present the sum of all answers divided by the number of students multiplying by 25 and from the result 25 is subtracted. Table 2 presents the answers haw much working on the project improve specific student's skills. All stills were improved. The top value was for design skill – "Create (a model or prototype)". The bottom value was for impact skill – "Solution in economic terms". The reason was students have only 10 weeks to learn the material and develop a prototype. The real implementation in the University web sites was not easy. Problems are with appropriate servers, people to enter the information, communication with the administration.

**Table 2. Student's skill improvement**

| SKILLS | % |
|---|---|
| **Opportunity skills** | |
| Identify (an opportunity) | 66.43 |

| | |
|---|---|
| Investigate (the market) | 52.14 |
| Create (a primary business model) | 52.14 |
| Evaluate (technical feasibility, customer value, societal benefits, economic viability) | 66.43 |
| Test (concepts quickly via customer engagement) | 55.71 |
| Assess (policy and regular issues) | 59.29 |
| **Design Skills** | |
| Determine (design requirements) | 77.14 |
| Perform (technical design) | |
| Analyze (solutions) | 70.00 |
| Develop (new technology) | 66.43 |
| Create (a model or prototype) | 91.43 |
| **Impact Skills** | |
| Solution in economic terms | 40.71 |
| Communicate (solution in terms of societal benefits) | 52.14 |
| Validate (market interest) | 41.43 |
| Develop (partnership and build a team) | 48.57 |
| Identify (supply chains distribution methods) | 45.00 |
| Project (intellectual property) | 55.71 |

Using the same metrics students were asked to measure the course objectives. The results are given in Table 3. It is clear that PBL and TBL gives very good results in obtaining the course objectives.

**Table 3. Obtaining the course objectivities**

| COURSE OBJECTIVES | % |
|---|---|
| Students will develop an in depth understanding of database systems, which is necessary for success in the majority of computer science endeavors. | 96.57 |
| Students will develop a database system application in a team framework. | 96.57 |
| Laboratories and exercises will give students experience with current technology and developments in the field of database systems. | 92.86 |
| Implement my own ideas following all necessary steps | 97.71 |
| Turn my work into real marketing product | 87.14 |

Using the same metrics students were asked how the project contribute to the preparation of the Entrepreneurial objectives. The results are given in Table 4. The top value is for Establish good communication skills: listening, speaking, and writing, the bottom value is for Understanding organizational structure and corporate culture. Students were not involved in some organization and cooperate culture. The results show that students fulfill the Entrepreneurial objectives, but lower that the course objectives.

**Table 4. Obtaining the entrepreneurial objectives**

| ENTREPRENEURIAL OBJECTIVES | % |
|---|---|

| | |
|---|---|
| Establish good communication skills: listening, speaking, and writing | 80.00 |
| Making decisions with incomplete information | 76.43 |
| Sharing the vision | 65.71 |
| Understanding organizational structure and corporate culture | 60.00 |
| Establish interpersonal skills | 76.43 |
| Understanding of the role of management (planning, organizing, directing and controlling) | 72.86 |
| Ability to resolve conflict | 61.57 |

Using the same metric the students were ask to measure the student involvement in the project development. The results are given in Table 5. All received value are high and not substantial different. Forming groups is very essential problem for the successes. Forming the group on the base of their interest was successful.

**Table 5. Student's involvement in the project development**

| PROJECT DEVELOPMENT | % |
|---|---|
| Discussion to promote critical thinking | 76.43 |
| Brainstorming discussion | 77.14 |
| Discussion to summarize and clarify | 87.86 |
| New topic discussion | 73.57 |
| Role-planning discussion | 80.71 |

The results of student's improvement for real live problems are given in Table 6. There are not substantial differences in the obtain values. The result shows that PBL and TBL prepare the student to solve real problems in their future work.

**Table 6. Student's improvement for real live problems**

| STUDENT IMPROVEMENT | % |
|---|---|
| Productive Collaboration | 83.57 |
| Resolute Integrity | 80.00 |
| Illuminating Communication | 72.86 |
| Multidimensional Problem Solving | 79.29 |
| Enterprising Attitude | 69.29 |
| | |

## CONCLUSION

Using PBL and TBL students were able to improve their enterprising behavior as developing business plan, case analysis, class presentation and discussion. They successfully incorporate: the written and oral presentations; individual self-assessment and team assessment tools; student progress reports and documentation. Working on project was a good experience, but required a lot of work. The students learned a lot about database systems and in the same time develop Entrepreneurial Mindset. Better results will be obtained in university with semester structure. The 10 terms was restriction and some of the business aspects are not obtain in enough degree. The paper contributes to research on entrepreneurial educations [7].

## ACKNOWLEDGE

This work was supported in part by the Kettering KEEN grand "Development of new database systems for Kettering students" and New England ICE Workshop.

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# VIRTUAL ENVIRONMENT SIMULATOR FOR EDUCATIONAL SAFETY CROSSING