Advanced SolidWorks course curriculum development

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Project Group #F

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1 BACKGROUND

1.1 Introduction

SolidWorks is one of the important computer application programs for engineering students and any person practicing engineering. As such, it is important to learn how to use the software to create 3D designs that give clients an impression of what the project will look like, once implemented. As a result, the project will deliver into the creation of a new course for the Mechanical Engineering Department, with the main objective being the expansion of features of SolidWorks, such as animations, multibody features, advanced sweeping, sketch blocks, advanced drawings, and rendering. At the end of the project, the team, comprising of students of engineering, software development, and web development will develop a creative yet simple to use course and system that will make it easy for students to learn how to use SolidWorks effectively and with much ease. Notably, students are in a unique position to develop a creative and flexible system while still having first-hand experience on the usability of the software and the problems encountered by new students. Moreover, the team endeavors to create a program, which encourages creativity and expands the possibilities of engineering through creative features. Ultimately, the course should be easy and enjoyable to encourage students to learn how to use it by practicing its use on a regular basis.

A major goal for the team is to create new and ingenious methods for use by students when learning the course. With the help of ethical guidelines, checks, and balances, the team plans to develop a system and course that adheres to the highest standards of engineering recognized by professional and academic engineering bodies. At the end of the course, a student ought to apply the knowledge creatively and practically in real-world engineering situations. As such, the project will address the issue of creating interest in students to adopt SolidWorks and use it regularly. What's more, new students find the current system rigid and quite hard to use, which creates a barrier to learning. With new, improved, and easy-to-use software, students should quickly learn how to use SolidWorks and use it on a regular basis.

1.2 Project Description

Following the original project description provided by the sponsor, this project will create a new "ME 180: Introduction to SolidWorks" course to be used by engineering students. The course should build on the harder aspects of the SolidWorks and making it easy to use and enhancing the students' creativity in the design process. At the end of the project, the team members should create a course outline for a 16-week sophomore-level SolidWorks course, determine if the course should meet 3x for 50 min or 2x for 75 min each week, create class tutorials for instructor to demonstrate SolidWorks features in class, and create homework instructions and assignments for the features.

The project should have a holistic course structure that will facilitate the teaching process as per the new creative design developed. The course outline provides a systematic approach to learning with an aim of ensuring that it can easily be taught and adopted by students and lecturers. A standard approach to learning and teaching will be used to design a model that allows the learning of the software in an enjoyable way [1]. The course outline uses the theoretical-practical approach to facilitate a wholesome learning process that will eventually impart the right skills in the students.

1.3 Original System

The original system started by teaching students orthographic projections, which shows how a 3D object can be represented in 2D. The aim was to lay a solid background to SolidWorks, which more or less builds onto orthographic projections [4]. The system teaches students in both theory and practical before

going into SolidWorks. The systems lessons ensure that the process of learning is in a systematic approach. Although useful, this system tends to waste a lot of time and exhausts most students. Therefore, with the new system, students are to learn the theoretical frameworks of each feature alongside its practical approach.

Moreover, students find it strenuous to learn the theory then practical models; therefore, the theory bit tends to be ignored. However, learning both at the same time reinforces whatever is being taught at each stage and makes learning interesting [1]. Presently, students learn several features and then do an assignment at the end. The aim is to aggregate all what is learned and apply it. In this case, a lot of emphasis is placed on theoretical learning and not enough use of creativity on new designs.

1.3.1 Original System Structure

The original structure was as follows: Introduction to SolidWorks – GUI, Toolbars, options, and first sketch, which introduced students to the basic tools in SolidWorks. Notably, this part introduces students to the SolidWorks interface. The interface uses many options to navigate and implement various designs and it is important for students to learn its tools [5]. Drawing Sketches then follow it for Solid Models hotkeys and gestures, and sketch tools introduction. Further, this part ushers students into the world of SolidWorks by showing them basic design tools that are used when making the first sketch that is the most important part of the design [4]. The sketch is what holds other features and it must be correct and accurate for the design to be stable and practical.

Next is adding relations and dimensions to sketches. The stage involves building on the sketches designed in the second stage. At this stage, students get to see how their sketches expand into designs that they envision. Moreover, students are to use creativity to shape the eventual appearance of the design. The next stage involves creating features and geometries [5]. At this stage, students learn how to reinforce building to withstand the weight of additional materials and features.

The course goes into the advanced level where students learn additional features that improve the structure and use sophisticated tools to bring the aesthetic aspect into life. Advanced dimensions, technologies and base features are combined with advanced modeling tools for sophisticated structures. Hence, an engineer's creativity comes into play as it involves expanding the dimensions of the structure [4]. At this stage, students learn how to use simple tools to perform advanced actions. With the help of advanced modeling tools, learners now combine tools and creativity to design structures that are both mechanically sound and innovative which is the meeting point between engineering and fashion.

The next stage involves sketch and lofted features and 3D sketches. It introduces the learners to the world of 3D and how to use it to create virtual reality. A good structure should be viewable from different angles and this stage enables students to format their designs in such a format. SolidWorks has tools that enable users to convert a 2D design into 3D that has made the designing stage easy as one can convert to any format with ease [5]. The lofted feature allows students to create solid designs before converting them into 3D. Moreover, the solid designs will aid in the creation of the final design.

Thereafter, learners are introduced to assembly modeling which involves bringing the various parts of the design together. The assembly stage uses dimensions, as the parts have to be combined into a single structure that is strong and structurally sound. This stage is followed by dimensioning, which defines the size and form of each feature of the structure [4]. Notably, this is important as learners get to see how the various dimensions of each component affect the overall structure. Finally, students are introduced to the basic and advanced stages of working with drawing views. It is meant to help them visualize their drawing as real-life structures with the expected problems they are likely to encounter in the actual

implementation of the drawings.

1.3.2 Original System Operation

The original system operated on a theory-practical framework. The idea is to introduce students to tools and their functions and usefulness before putting them to use. Notably, this model allows students to systematically build on their knowledge and build their structures. Moreover, it introduces basic features followed by advanced ones. However, basic principles and advanced ones are not introduced at the same time. The system builds the basic structures before combining them into a single structure that is structurally sound.

1.3.3 Original System Performance

Presently, the system is strenuous on students as the tools being used are complex and some of them are repetitive of each other. The structure is built slowly and takes much longer than it should. Aspects such as weight, volume, and power are implemented separately as the structure is build per piece. The old system's features and tools do not permit the combination of a number of dimensions, which can reduce the time, and speed with which a project is done. SolidWorks has various features and tools, which can be combined to perform tasks and designs together for efficiency and speed. The overall performance of the structure is practical and sound.

1.3.4 Original System Deficiencies

The current system makes it hard to explain engineering dynamics to customers. A good system is one that should be simple to explain to a nonprofessional while ensuring that engineering concepts are still maintained. The system is hard to navigate making it hard for customers to understand the various dynamics of the system. Additionally, the system does not meet the quality function deployment as it is rigid, making it hard to incorporate design and product quality into customer requirements. With little flexibility to implement extreme creativity with designs, it is hard to design structures that are structurally sound.

2 REQUIREMENTS

The customer requires sketches of the work, 3D sketches, ideas on tutorials, and how the course is to be implemented. Moreover, the client needs quizzes as these will be used in the actual implementation of the project. The project will heavily rely on real-life examples as the course is supposed to equipment learners with skills, which can be used in real life situations. Since the course involves a lot of classwork, there should be a section on how the learners will work in groups in the actual learning to get more benefits.

2.1 Customer Requirements (CRs)

The overall objective is to create simple to use SolidWorks software that incorporates engineering standards and learning into the system. The project should then develop a course outline that will show the practical steps to be used in learning how to use the improved software. The customer would like a system that can be easily adopted and used by students but which is flexible to accommodate creativity and push engineering boundaries [3]. The main weightings include the ability to meet engineering standards while facilitating easy usage and making room for creativity [5]. Therefore, the system should allow users to create phenomenal structures that push engineering boundaries.

2.2 House of Quality (HoQ)

In table 1, our group indicate the customer requirements with their weights for this project.

Table 1: House of Quality

House of Quality (HoQ)	
Customer Requirement	**Weight**
1. more acutal work in solid work	6
2. 3-D sketches	7
3. quizes	4
4. TA secions	7
5. work in groups	8
6. work more on totorials	9
7. take examples from real life	8
8. theme	8
Approval (print name, sign, and date):	
Team member 1: Muhammad Alhajri	02/13/17
Team member 2: Naser Alhajri	02/13/17
Team member 3: Yousef Alhaddad	02/13/17
Team member 4: Mohammad Alfadhli	02/13/17
Team member 5: Abdualziz Alajmi	02/13/17

3 EXISTING DESIGNS

Autodesk, one of the most popular programs in existence is quite hard to use especially for new designers. The program has many expert-level tools, which are hard to use and understand for beginners. The program is also very heavy, which makes it hard to use on slow processors. In 3D printing, Fortus 300 is popular amongst students. However, the program lacks the ability to integrate well with some design programs such as Auto CAD.

3.1 Design Research

The SolidWorks design was developed to ensure that relations and dimensions control geometry so that designers have the creative freedom to design structures that meet client expectations. The program is designed in such a way that the engineer can easily bring their creations into being with ease to push engineering boundaries. The allowance to revise the system to incorporate new features is what facilitates the implementation of the project [2]. Therefore, SolidWorks gives users the freedom to customize their needs with little difficulty.

In the research stage, students approach to learning is studied. Notably, students enjoy using SolidWorks as it enables them to create designs that are creative. However, the interface can be intimidating for first-time users as it has too many tools, some of which can be combined for efficiency. Moreover, some students have found shortcuts on how to use various tools for efficiency in creating designs. As a result, there is no need to learn how to use some tools as they quickly become obsolete and add to the burden of what students must learn.

A comparison between Autodesk and SolidWorks reveals that both systems have similar features and capabilities. However, SolidWorks does not integrate well with Microsoft Office Suites, making it hard to import features from these programs. It is hard to save designs on cloud systems in real time on SolidWorks, a major shortcoming as cloud computing is the modern way of saving items for access with ease [2]. Therefore, this means that live review and editing is hard and teams working on a similar project cannot work remotely on the project at the same time.

3.2 System Level

The step looks at the existing designs and what needs to be improved to make them more responsive to customer needs. The new designs will use SolidWorks to develop systems that are according to the clients' specifications and present the 3D designs to the client for a virtual tour of the actual project and expected final design.

3.2.1 Existing Design #1: Autodesk

In this project, the program allows users to design heavy designs with ease. However, the complexity of the tools makes it hard for beginners and poses a challenge for those who want to develop complex projects using it. Additionally, the program does not have a connection to cloud computing, an ability that helps a teamwork together on a project from remote connections.

3.2.2 Existing Design #2: AutoCAD

AutoCAD requires lots of training to use and perfect as its tools are professional-level and most students find it hard to understand. It also has many bugs and is hard to integrate on the most common computer programs. The base views are also very basic and designing complex designs with existing templates has proven to be very hard. Most people, therefore, lack the ability to freely explore their creativity with the existing base views. It is also hard to view designs in 3D, a feature that is very important for students designing complex designs.

3.2.3 Existing Design #3: AutoCAD 3D Designs

AutoCAD's 3D feature maintains the same provisions as previous versions, giving problems to users. Although it is a strictly 2D and 3D software, it remains, quite challenging to use its 3D feature with ease. It is also hard to use for very heavy projects, which limits the amount of work that one can do with it. As a result, it has to be used in conjunction with other programs.

3.3 Subsystem Level

The section will delve into the specifications of each design and how the final design will solve the clients' problems. The subsystem level describes how the systems work and how this will solve existing problems. The program is also hard to integrate on Windows 7 and Windows Vista.

3.3.1 Subsystem #1: Designing AutoCAD to overcome the 3D problem

The new design will facilitate the viewing of designs in normal viewing and in 3D. Designers enjoy viewing their concepts in sketches and in 3D, as this facilitates easier editing.

3.3.1.1 Existing Design #1: Modeling AutoCAD to be Compatible with Windows 7 and Vista

Windows is one of the most commonly used programs for most computer users. Windows 7 comes with advanced features, which make working with it easier and faster even for first time users. The new design will be revamped using programming to facilitate easier compatibility and ease the pain of most users who currently have a problem with AutoCAD.

3.3.1.2 Existing Design #2: Modeling AutoCAD Tools for Starters

At this stage, the design will be altered to ease the process of identifying tools and using them appropriately. The tools will have icons that are easy to identify and self-explanatory. The tools will also have names or can be identified upon hovering on them. The idea is to make the program very simple for beginners and intermediate users, who are used to other simpler programs like Catia. Bearing in mind those engineers and architects, the design use it needs to be simple so that it can cut across the different fields with ease.

3.3.2 Subsystem #2: Autodesk

In order to design complex designs, students often turn to Autodesk, which has advanced features and easy compatibility with other programs. Autodesk has simple-to-use icons and tools, which help new users, navigate around easily. The icons make it easy for engineers and architects to use the program with no help. The project is to, therefore, make 2 versions that are more specialized for each field.

3.3.2.1 Existing Design #1: Autodesk for Engineers

The standard program caters to the needs of engineers and architects. However, with a specialized program, engineers will have advanced features and tools strictly related to the field. The new program will have the basic features of Autodesk, meaning that even architects can still use it, but it will also incorporate specialized features for engineering.

3.3.2.2 Existing Design #2: Autodesk for Architects

The current design has too many features, most of which are not suitable to architecture. As such, these features make it very heavy and complicated for new users. The specialized Autodesk for architects will feature the basic features but be more inclined towards architecture. There will also be new tools, which will help those in different fields such as animation to use it with eases.

3.3.3 Subsystem #3: Fortus 400

The existing design has interesting features, which are compatible with most programs such as SolidWorks. However, it requires better integration by enhancing its features to facilitate easier integration. The basic design is meant to help it work well with other programs for 3D viewing but it is very hard to use with programs such as Autodesk.

3.3.3.1 Existing Design #1: Redesigning Fortus 400

In this design, the existing design will have additional features that integrate well with all other programs.

The idea is to have it installed as part of the bigger program for ease of use. There will also be enhanced features to allow for 2D and 3D viewing.

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