INTRODUCTION

Although learning styles are perceived diversely, they have important impacts on learning. Teachers bear tremendous responsibility in revealing which of the learning styles the students possess, namely Abstract Conceptualization (AC), Concrete Experience (CE, Active Experimentation (AE), Reflective Observation (RO). If, in professional training, teachers learn what kind of learning styles their students possess and arrange learning environments accordingly, they will be able to offer a more effective and efficient professional education. Learners are responsible from their self-learning while teachers play a role in assisting the learners. It is considered that learners can learn more effectively if they are aware of the best learning style that suit themselves. To this end, Prof. Dr. Eda GÜRLEN, Teaching Fellow, Faculty of Educational Sciences, Hacettepe University provided training in "Teaching by Learning Styles-Regulation of Learning Process" to the teachers working at project partner institutions in Nr. 3 "Teacher Education" intellectual output study in the project study titled **"Future-Ready Ed Rights Skills to Right Job Nr. 2018-1-TR01-KA202-059505"**. Equipped with this training, teachers prepared the curriculum in line with learning styles of students within the context of Nr.4 "Curriculum Development" intellectual output work package. In Nr.5 intellectual output work package, the effects of curriculum and learning environment that conforms to learning styles as a result of the studies that have been conducted within the scope of Nr. 3 and 4 intellectual output work packages on academic achievements of students were researched in Computer Aided Design and Manufacturing (CAD/CAM) lesson specific to the use of Loft to create solid unit. The report of the study is presented below.

PROBLEM SENTENCE

What is the effect of a Kolb-based curriculum on the academic achievement of solid creation unit using Loft in Computer Aided Design and Manufacturing (CAD/CAM) lesson?

1. Is there any statistically significant difference between pretest scores of the experimental group that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM lesson?

a. Is there any statistically significant difference between **total pretest scores of the experimental group** that receives Kolb-based curriculum and the control group that

receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

b. Is there any statistically significant difference between **pretest theoretical exam scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

c. Is there any statistically significant difference between **pretest practical exam scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

2. Is there any statistically significant difference between **gain scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

a. Is there any statistically significant difference between **total gain scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

b. Is there any statistically significant difference between **theoretical exam gain scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

c. Is there any statistically significant difference between **practical exam gain scores of the experimental group** that receives Kolb-based curriculum and the control group that receives conventional training in solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM Lesson?

ASSUMPTION AND LIMITEDNESS

The assumptions of the research include that the uncontrollable variables in experimental and control groups affect the students in both groups in the same way and that the expert opinions which have been consulted upon to define the content validity of data collection tools are adequate.

The research is limited to the solid creation unit using Loft in Computer Aided Design and Manufacturing CAD/CAM lessons at vocational schools for the spring semester of 2020-2021 academic year and 43 male students studying at Sincan Erkunt Vocational Training Center affiliated to the Ministry of National Education (MoNE) in Sincan, Ankara.

METHODOLOGY

This chapter provides information about the methodology of research, research process, working group, data collection tools and data analysis.

METHODOLOGY OF RESEARCH

This study analyzes the effectiveness of a curriculum that is prepared based upon Kolb learning styles on academic achievement. Aiming at testing the cause-and-effect relation between variables, this study serves as experimental research (Büyüköztürk et. al., 2020). Since experimental and control groups have been defined using existing classes, the design of the study is static group pretest-posttest design as one of the weak experimental designs. The design of the study is demonstrated in Table 1 below.

Table 1: Experimental design of study

Group	Pretest	Process	Posttest
Experimental Group	Theoretical Exam	Curriculum based on	Theoretical Exam
	Practical Exam	Kolb learning style	Practical Exam
Control Group	Theoretical Exam	Conventional	Theoretical Exam
	Practical Exam	Training	Practical Exam

WORKING GROUP

This research, where static group pretest-posttest experimental research design was used, has been conducted by using two groups, namely experimental and control groups. Total 43 volunteered male students studying 12th grade at Mechanic Technology, Sincan Erkunt Vocational Training Center attended the research during the spring term of 2020-2021 academic year. 43 students were studying at classes named MAK 3A, MAK 3B and MAK 3C, where students at class MAK 3A were included in control group while students at MAK 3C were included in experimental group. The first six of the students at class MAK 3B were taken into control group while the last six of them were taken into experimental group according to the list of students. Consequently, two groups were generated; 22 of total 43 students were included in experimental and 21 were included in control group.

DATA COLLECTION TOOLS

Two exams, namely theoretical and practical, have been developed to quantify the outcomes to be addressed within the scope of this study as pretest and posttest. While theoretical test consists of multiple-choice questions, practical exam contains eight tasks and questions based upon student practice. The table of specifications given in Table 1 was generated before preparing theoretical and practical exams. The grading scale was used for scoring practical exams. This section contains information about development of data collection tools used in the study.

Table 1. Association of the outcomes of solid creation unit with Loft and theoretical exam

Outcome	Question Number
Comprehends sketch and extrude sections in Solidworks interface.	3.14.15.
Comprehends creating different 2D profiles in on two different surface plans.	4.6.8 11.12 21.24.
Transforms different profiles to 3D solid model with Loft command and	29. 30. 32. 33.34.
Draws spur gear using Loft command.	
Draws helical gear using Loft command.	
Draws conical gear using Loft command.	
Examines and revises, if necessary, Torques of 3D solid model of different profiles with Loft command.	37.40.

questions

Outcome	Question Number
Comprehends sketch and extrude sections in Solidworks interface.	1, 4
Comprehends creating different 2D profiles in on two different surface plans.	2, 3, 5, 6
Transforms different profiles to 3D solid model with Loft command and	7
Draws spur gear using Loft command.	
Draws helical gear using Loft command.	
Draws conical gear using Loft command.	
Examines and revises, if necessary, Torques of 3D solid model of different profiles with Loft command.	8

Table 2. Association of solid creation unit using Loft with practical exam questions

DEVELOPMENT OF THEORETICAL EXAM

In the development of theoretical exam, total 40 multiple-choice items were prepared based on the table of specifications (ANNEX-1). Prepared by question authors, such items were examined by a subject expert and an assessment and evaluation expert. As a result of the examinations, several suggestions were made for the items, which were then finalized for use in pretesting in accordance with such suggestions.

Pretesting was conducted with 45 students from Sincan Erkunt Vocational Education Cener and 37 students from ASO Technical College who have been given the unit "solid creation with Loft" in "Computer Aided Design and Manufacturing CAD/CAM" lesson, all studying 12th grade in Mechanic Technology for the academic year of 2020-2021. Due to the pandemic related restrictions in force during the period of research, pretesting had to be conducted with 82 students instead of the targeted number of students. Students were given 80 minutes for pretesting and were provided the same exam environment with the final test environment.

Data obtained from 82 students were examined and data obtained from 51 individuals were found to be appropriate for analysis and TAP (Test Analysis Program) was used for item analysis. Statistics such as item difficulty and item discrimination that have been obtained as a result of item analysis are provided in Annex-2. Annex-2 also manifests that most item discrimination levels were below 0.30 and therefore, discrimination was not at desired levels

(Crocker and Algina, 1983). Those items, which had low discrimination levels and were found to be nonconforming to final application by the program, were removed from the test, respectively and item analyses were repeated after removing each test item. Item analyses completed and results obtained were shared with question authors, who were then consulted upon to select the items to be used in final application considering the distribution in the table of specifications. Four items, included amongst the selected items with discrimination level between $0.30 > r_{jx} > 0.20$ were examined in details. The distribution of selections in such four items suggested a conglomeration mostly on one option and question authors were asked to revise such items accordingly to generate the final test (Annex-3). As a result, item analyses of the multiple-choice test consisting of 18 items were given in Annex-4 and KR-20 reliability coefficient of the test was found 0.60. It is safe to mention that the reliability coefficient for classroom achievement test should be at least 0.50 (Kehoe, 1995; as cited in: Fliszar, 2009) and the obtained 0.60 level is adequate for the application.

DEVELOPMENT OF PRACTICAL EXAM

A practical exam has been prepared to measure the outputs addressed within the context of the study. There are eight tasks in the said practical exam. Tasks prepared and the grading key for such tasks have been examined by a subject expert and an assessment and evaluation expert. Practical exam and grading key have been finalized according to the suggestions provided as a result of such examinations (Annex-5 and Annex-6). Two graders were used to grade the practice exam. Graders have consecutively monitored and simultaneously evaluated student practices during practical exam.

For the examination of inter-rater reliability, Pearson Product-Moment Correlation Coefficient was calculated by using total scores graded to students by raters (Kutlu, Doğan and Karakaya, 2017). Whereas, inter-rater correlation was 0.96 in pre-practice while it was 0.98 in post-practice. The indicator of inter-rater reliability, being the correlation coefficient, ranges between 0 and 1. The closer the calculated correlation value is to 1, the higher is the rater reliability and the more consistent is the scores graded by raters. Inter-rater reliability coefficients acquired in the study are significantly high. As a result, scores given by two raters were averaged in determining the scores obtained in practical exam.

RESEARCH PROCESS

PREPARATION OF TRAINING PROGRAM

In the context of the study, an education program based upon Kolb learning style has been developed and the development stages of such education program have been addressed in details in Output 4 Report of the project. For this reason, the development stages of education program are not reiterated in this report.

STAGES OF EXPERIMENTAL PROCESSES

At the first stage of experiment process, students both in experimental and control group were tested at two stages with theoretical and practical exams. All necessary measures have been taken considering the ongoing pandemic during exams. Theoretical exam was given at a 40-minute single session while practical exam was given in four sessions, two in the morning and two in the afternoon, on different days following the theoretical exam. Each group in practical exam, excluding the last group (last group of 13 students) consisted of 10 students. Each group was given 80 minutes to perform the practices at CAD/CAM (Computer Aided Design) Laboratory.

Upon completion of pretest practices, education process continued for 4 weeks totaling up to 16 hours with 2 hours for theoretical and 2 hours for practical training each week. In each group, theoretical lessons were given with students together (22 students in experimental group and 21 students in control group) while practical lessons were conducted in two different groups within each group. Practical exams were held at CAD/CAM (Computer Aided Design) Laboratory in two different groups due to measures taken against pandemic conditions.

Kolb-based education program was applied to experimental group as part of one learning style per week. In this way, four different learning styles were applied and digital education contents that are not included in conventional education (animations, simulations and AR augmented reality applications) were utilized.

Spur Gear application was conducted on conventional basis using a different Loft command each week in control group. Applied courses of control group were given in a different CAD/CAM (Computer Aided Design) Laboratory than that of experimental group.

Upon completion of education, posttest was conducted in a way to meet the conditions stipulated for pretest.

ANALYSIS OF DATA

Experimental and control groups were subject to pretest-posttest in the study with the objective of comparing the change in achievements of students in different groups. As specified in data collection tools chapter, data collection tools consist of two exams, namely theoretical and practical.

In generating the data set to be used in the analysis, exam papers for theoretical exams were delivered to project team leaders who calculated total scores by entering the reply patterns of each exam paper in Microsoft Excel to generate data set for theoretical exam. For practical exams, grading keys filled in by raters were delivered after exam to project team leader who generated data set for practical exam. All data sets for pretest and posttest application were sent by the project team leader of Sincan Erkunt Vocational Education Center to the researches involved in this project.

In optimizing the data set for analysis, all exam scores of experimental and control groups were collected in a single data set. A total score was generated consisting of total scores of theoretical and practical exams. To determine whether any statistically significant differences exist in academic achievement between experimental and control groups, both total scores and theoretical and practical exams have been separately examined. IBM SPSS package was used for statistical comparison.

To determine whether any statistically significant differences exist in posttest-based success grades between groups, it was aimed at eliminating the effect of pretest on posttest and therefore, data were firstly subject to covariance analysis. Necessary assumptions were primarily examined to validate covariance analysis. For this reason, certain assumptions such as normality, linearity, homogeneity of variances, homogeneity of regression in groups were examined, however, it was found that the research data failed to fulfill the assumption of homogeneity of variances. Tabachnick and Fidell (2007) suggest to examine if there is any statistically difference in gain scores (posttest score – pretest score) between groups in cases where covariance analysis assumption is not fulfilled. In this way, it may be possible to answer this question: "Does Kolb-based curriculum change the academic achievements of students more than the conventional education?"

Consequently, in examining the subproblems addressed in the study, independent samples T-test was utilized to determine if gain scores have statistically significant difference between groups and Mann-Whitney U test was utilized to determine if pretest in groups have statistically significant difference. Assumptions of the independent samples T-test analysis manifest that normality assumption has been fulfilled yet group variances were not equal. Therefore, as a result of T-test analysis, the values indicating such inequal variances are shown in a table.

FINDINGS

This chapter addresses the findings about research problems.

FINDINGS ABOUT THE FIRST SUBPROBLEM

In the first subproblem of the research, Mann-Whitney U test was applied in order to determine if there is any statistically significant difference between the experimental group, which was subject to the curriculum based upon Kolb learning styles, and the control group, which was subject to conventional applications in Computer Aided Design and Manufacturing CAD/CAM lesson. For this purpose, total score, theoretical exam scores and practical exam scores were examined separately.

Findings about Total Scores

The results of Mann-Whitney U test about total scores obtained from the total of theoretical and practical exams by experimental and control groups are provided in Table 3 below:

Table 3: U-Test Result for Pretest Total Scores by Groups

GROUP	n	Mean Rank	Total Rank	U	p
CONTROL	21	19.93	418.50	187.500	.290
EXPERIMENTAL	22	23.98	527.50		

Whereas, pretest total scores manifest no significant difference by groups ($U = 187.50$, p<.01). Despite the fact that mean rank of students is 23.98 in experimental group and 19.93 in control group, this finding does not make a statistically significant difference.

Findings about Theoretical Exam Score

The results of Mann-Whitney U test for theoretical exam scores by experimental and control groups are given in Table 4 below:

Table 4: U-Test Result for Pretest Theoretical Exam Scores by Groups

GROUP	n	Mean Rank	Total Rank	U	p
CONTROL	21	21.10	443.00	212.00	.635
EXPERIMENTAL	22	22.86	503.00		

Whereas, pretest theoretical exam scores do not manifest significant difference by groups ($U = 212.00$, p<.01). Despite the fact mean rank of students is 22.86 in experimental group and 21.10 in control group, this finding does not make a statistically significant difference.

Findings about Practical Exam Score

The results of Mann-Whitney U test for practical exam scores by control and experimental groups are given in Table 5 below:

Table 5: U-Test Result for Pretest Practical Exam Scores by Groups

GROUP	n	Mean Rank	Total Rank	U	p
CONTROL	21	19.10	401.00	170.00	.138
EXPERIMENTAL	22	24.77	545.00		

Whereas, pretest total scores do not manifest significant difference by groups ($U = 170.00$, p<.01). Despite the fact that mean rank of students is 24.77 in experimental group and 19.10 in control group, this finding does not make a statistically significant difference.

FINDINGS ABOUT THE SECOND SUBPROBLEM

In the second subproblem of the research, independent samples T-test was applied in order to determine if there is any statistically significant difference in gain scores between the experimental group, which was subject to the curriculum based upon Kolb learning styles, and the control group, which was subject to conventional applications in Computer Aided Design and Manufacturing CAD/CAM lesson. For this purpose, total, theoretical exam and practical exam gain scores were examined separately.

Findings about Total Scores

The results of T-test on total gain scores obtained from the total of theoretical and practical exams by experimental and control groups are provided in Table 6 below:

Table 6: T-Test Result for Gain Scores by Groups

GROUP	N	$\bar{X}$	S	sd	t	p
CONTROL	21	13.10	5.67	28.332	-6.68	.000
EXPERIMENTAL	22	34.21	13.63			

Whereas, gain scores manifest a significant difference by groups ($t_{28.332} = -6.68$, p<.01). The average gain score of students in experimental group ($\bar{X} = 34.21$) is higher than that in control group ($\bar{X} = 13.10$).

Findings about Theoretical Exam Score

The results of T-Test for theoretical exam gain scores by experimental and control groups are provided in Table 7 below:

Table 7: T-Test Result for Theoretical Exam Gain Scores by Groups

GROUP	N	$\bar{X}$	S	sd	t	p
CONTROL	21	9.53	5.01	30.831	-3.86	.001
EXPERIMENTAL	22	18.95	10.24			

Whereas, gain scores manifest a significant difference by groups ($t_{30.831} = -3.86$, p<.01). the average gain score of students in experimental group is ($\bar{X} = 18.95$) higher than that of in control group ($\bar{X} = 9.53$).

Findings about Practical Exam Score

The results of T-test for practical exam gain scores by experimental and control groups are provided in Table 8 below:

Table 8: T-Test Result for Practical Exam Gain Scores by Groups

GROUP	N	$\bar{X}$	S	sd	t	p
CONTROL	21	3.57	3.75	31.502	-6.61	.000
EXPERIMENTAL	22	15.27	7.36			

Whereas, gain scores manifest significant difference by groups ($t_{31.502} = -6.61$, p<.01). The average gain score of students in experimental group ($\bar{X} = 15.27$) is higher than that of in control group ($\bar{X} = 3.57$).

DISCUSSION AND CONCLUSIONS

The study aims at researching the effects of an education program that has been developed based upon Kolb learning styles for Computer Aided Design and Manufacturing CAD/CAM lesson on the achievement of students. To this end, experimental research design that includes 43 volunteered male students studying at Sincan Erkunt Vocational Education Center for the academic year of 2020-2021 was utilized to create experimental and control groups. The students in experimental group have been given Kolb-based curriculum for four weeks while the students in control group have been given conventional education. A pretest consisting of theoretical and practical applications was applied to students prior to the onset of experimental process. The results obtained from the pretest have been examined in regards to total score (theoretical practical exam score + practical exam score), theoretical exam score and practical exam score to determine if statistically significant differences occur between groups. Consequently, no statistically significant difference was found between experimental and control groups in terms of pretest.

Experimental process has continued for four weeks in total, at the end of which period students were subject to posttest. Posttest had the same structure with pretest and both tests were applied under the same conditions. In examining if there is statistically significant difference in posttest scores between groups, the study aimed at eliminating the effects of pretest scores and conducting a covariance analysis. However, due to the failure to meet assumptions, the difference between pretest and posttest was obtained to examine if there is statistically significant difference in gain scores between groups. Consequently, and as a result of the analyses based upon gain scores, statistically significant differences were found between total gain score, theoretical exam gain score and practical exam gain scores in experimental and control groups. The average scores obtained manifest that such significant difference is in favor of the experimental group.

As a result, this study conducted at Sincan Erkunt Vocational Education Center for the academic year of 2020-2021 may suggest that the academic achievement of the experimental group that has been applied the curriculum developed based upon Kolb learning style in solid creation unit with Loft in Computer Aided Design and Manufacturing CAD/CAM lesson, is statistically higher than the academic achievement of the control group that has continued conventional education.

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ANNEXES

ANNEX– 1: 40 PRETEST QUESTIONS

QUESTION 1) Which of the following menus is used to enter part design in SolidWorks interface?

        A) Assembly Design
        B) Part Design
        C) Drawing Design
        D) Extrude Design

QUESTION 2) Which of the following parts is used to open a plan when switched to design interface?

        A) Sketch
        B) Extrude
        C) Mold
        D) Render

QUESTION 3) In which of the following menus is reference geometry in SolidWorks included?

        A) File
        B) Edit
        C) View
        D) Add

QUESTION 4) Which is appropriate to start from on screen to drawing when Sketch is in active mode on Front Plane?

        A) Any part of the screen
        B) In the middle of screen
        C) The intersection points of red arrows on screen
        D) Coordinate plane on lower left corner of screen

QUESTION 5) Which of the following commands is used to draw a tangent arc in Sketch section?

        A) Rectangle
        B) Circle
        C) Line
        D) Tangent Arc

QUESTION 6) Which of the following pixels is used to understand if involute curves have properly connected with each other?

A) Section View
B) Intersection view
C) Line view
D) Center line

QUESTION 7) Which of the following commands should be used to create a spur gear profile after drawing curves?

A) Linear Sketch Pattern
B) Regular Sketch Pattern
C) Circular Sketch Pattern
D) Rectangular Sketch Pattern

QUESTION 8) Which of the following commands remove remaining arcs to make gear profiles made with involute curves visible?

A) Trim
B) Mirror
C) Offset
D) Convert

QUESTION 9) Which of the following commands is used for drawing arc?

A) Mirror
B) Grid
C) Arc
D) Trim

QUESTION 10) Which of the following is used to calculate major diameter, pitch circle, thread minor diameter and involute curves?

A) Geometrical rules
B) Trigonometrical rules
C) Pythagorean relation
D) Derivative and integral calculations

QUESTION 11) Which of the following is used for dimensioning in SolidWorks 3d Industrial design program?

A) Extrude Boss
B) 3d Sketch
C) Smart Dimension
D) Surface

QUESTION 12) Which of the following is used to correct a mistaken dimension in dimensioning?

    A) Delete the dimension
    B) Double click on dimension
    C) Revert with back button
    D) Erase the drawing entirely

QUESTION 13) What is called to measure all sizes in SolidWorks program according to a reference edge?

    A) Baseline Dimensions
    B) Vertical Dimensions
    C) Angular Dimensions
    D) Horizontal Dimensions

QUESTION 14) Which of the following planes is used for 2nd profile while designing a spur gear using front plane to prepare 1st Profile?

    A) Front plane
    B) Top Plane
    C) Right Plane
    D) Bottom Plane

QUESTION 15) Which of the following methods is used to calculate the distance to zoom out the plane to be used for 2nd profile in order to determine the right conical angle for conical gear?

    A) Trigonometry
    B) Pythagorean relation
    C) Derivative
    D) İntegral

QUESTION 16) Which of the following is drawn in Sketch section of a new plan to be opened after drawing 1st profile of a spur gear?

    A) Major circle
    B) Dedendum circle
    C) Axis as inclined as helix angle
    D) Axis as inclined as conic angle

QUESTION 17) Which of the following is an option used to show a toolbar either disappeared or not shown in screen back again?

    A) Insert > Customize Menu
    B) Tools > Options
    C) View> Toolbars
    D) Tools SolidWorks Explorer

QUESTION 18) Which of the following commands is used to draw an arc with known focal point and radius in Sketch section?

    A) Tangent arc
    B) Circle
    C) Spline
    D) Center point Arc

QUESTION 19) Which of the following should be performed when involute curves drawn to create a gear profile lie beyond the profile boundary areas?

    A) Redraw the arc with back button
    B) Trim the abundant parts with Trim the closest button
    C) Delete the abundant parts with Delete button
    D) Measure and revise the arc

QUESTION 20) Which of the following machine element criteria is used to determine the quantity of reproduction of involute curves that generate the thread profile with pattern command?

    A) Spiral
    B) Cycle
    C) Pitch
    D) Helix

QUESTION 21) How does the gear profile appear when a thread profile is reproduced?

    A) One tooth fill and one tooth spacing
    B) One tooth fill and two teeth spacings
    C) Two teeth fill and one tooth spacing
    D) Two teeth fill and two teeth spacing

QUESTION 22) Which of the following is a determinant parameter for helical and conical angle of a gear?

    A) Construction
    B) Rotation speed

C) Number of wheels
D) Strength

QUESTION 23) Which of the following is a command used to generate a gear keyway quadrant?

A) Line
B) Trim
C) Rectangle
D) Snap

QUESTION 24) Which of the following elements do helical and conical angles determine?

A) Part material
B) Major thread diameter
C) Number of threads
D) Minor thread diameter

QUESTION 25) Which of the following is done to calibrate helical angle?

A) Click on endpoints of one of the centerlines
B) Click on the linear part of centerlines at the same time
C) Click on the endpoint of centerline and origin point
D) Double click on centerlines

QUESTION 26) Which of the following command symbol is used for smart dimensioning on design screen?

A)   B)   C)   D)

QUESTION 27) How is the Loft connector determined to generate a spur gear?

A) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear in 2nd Profile.

B) 2nd Involute Curve of gear in 1st Profile with 1st Involute Curve of gear in 2nd Profile.

C) 2nd Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear in 2nd Profile.

D) 1st Involute Curve of gear in 1st Profile with 1st Involute Curve of gear in 2nd Profile.

QUESTION 28) How is the Loft connector determined to generate a helical gear?

    A) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear in 2nd Profile.

    B) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on inclined axis in 2nd Profile.

    C) 1st Involute Curve of gear in 1st Profile with 1st Involute Curve of gear on inclined axis in 2nd Profile.

    D) 2nd Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on inclined axis in 2nd Profile.

QUESTION 29) How is the Loft connector determined to generate a Conical Helical Gear?

    A) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on 2nd Profile in conical angle

    B) 1st Involute Curve of gear in 1st Profile with 1st Involute Curve of gear on 2nd Profile in conical angle

    C) 2nd Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on 2nd Profile in conical angle

    D) 2nd Involute Curve of gear in 1st Profile with 1st Involute Curve of gear on 2nd Profile in conical angle

QUESTION 30) How do you verify that a conical gear 3D model has been correctly generated after Loft command?

    A) When yellow-colored preview occurs
    B) When solid occurs without sketch
    C) When solid does not occur
    D) When two different bodies occur

QUESTION 31) Which of the following connections should occur between gears when a helical gear is created with Loft command?

    A) Diagonal
    B) Flat
    C) Parabolic
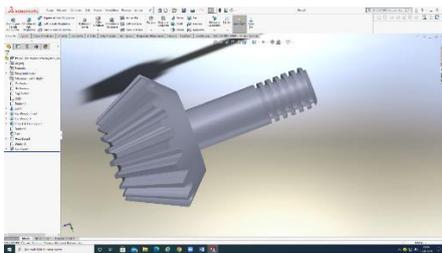   D) Inclined

QUESTION 32)
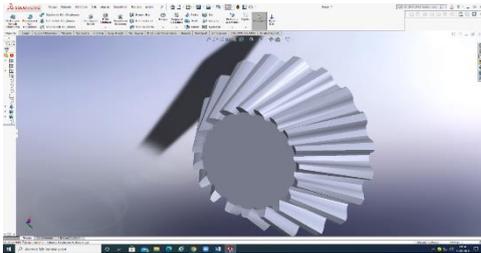
What is the name of the gear shown above?

      A) Conical Gear
      B) Conical Helical Gear
      C) Helical Gear
      D) Rack Gear

QUESTION 33)


Which of the following is the screw threaded in arbor part of gear profile shown above?

      A) Triangle right screw
      B) Trapezoid right screw
      C) Square right screw
      D) Trapezoid left screw
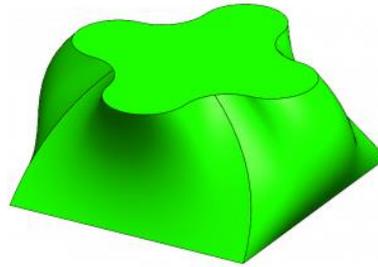
QUESTION 34) What is the function of symbol on Extrude toolbar in SolidWorks?

      A) Create solid with extrusion
      B) Cut with extrusion
      C) Create solid with sweep
      D) Create solid with Loft

QUESTION 35)
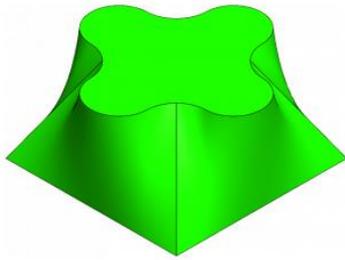
A   **B**

The figure above illustrates two 3D models drawn with Loft command. Which of the following should be done during designing in order to obtain the model on the Right (B) from the Model on the Left (A)?

    A) Draw interplanar gridlines
    B) Draw interplanar Spline
    C) Draw interplanar arc
    D) Draw interplanar vertical line

QUESTION 36)


Which of the following identifications must **<u>not</u>** be made to draw the 3D model in figure with LOFT command?

    A)   Three planes on front plane
    B)   Two planes, Front and Top plane
    C)   Two planes, Right and Top plane
    D)   Three planes, Front, Right and Top plane

QUESTION 37) Which of the following information is **<u>wrong</u>** about the grid curves for 3D model design using Loft command**?**

    A) Draw grid curves with spline command.
    B) Grid curves should intersect with all profiles.
    C) There is no limitation on the number of grid curves.
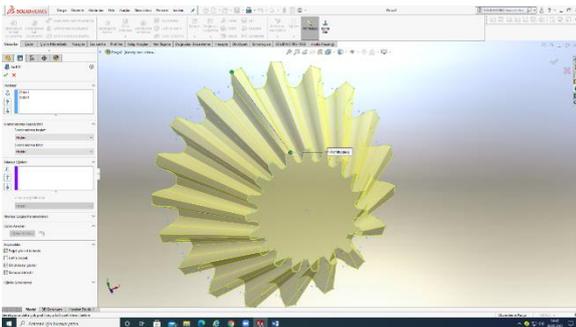   D) Grid curves may intersect on points.

QUESTION 38)
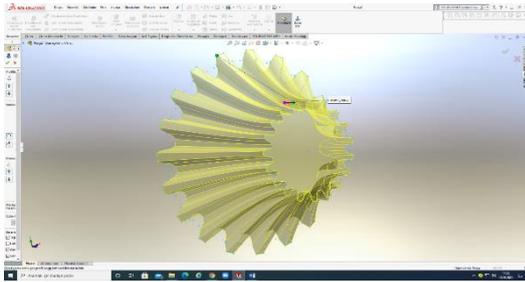
Which of the following should be done in case of the above torque image?

    A) Apply again the Loft command
    B) Use start and end limitation command
    C) Perform Extrude Cut
    D) Perform Revolved Cut

QUESTION 39)

Which of the following is correct for the above torque image?

    A) There is no mistake
    B) There is Revolved Cut mistake
    C) There is Extrude Cut mistake
    D) There is reference point mistake

QUESTION 40) Which of the following is a mistake that causes torque after applying Loft command?

    A) Matrix
    B) Determinant
    C) Spatial deviation
    D) Mass deviation

ANNEX– 2: PRETEST ITEM ANALYSIS RESULTS IN 40 QUESTIONS

Question No	Item Difficulty Index	Item Discrimination Index	Question No	Item Difficulty Index	Item Discrimination Index
S1	0.65	0.19	S21	0.41	0.37
S2	0.75	0.07	S22	0.29	0.14
S3	0.41	0.26	S23	0.65	-0.07
S4	0.57	0.22	S24	0.53	0.28
S5	0.69	0.02	S25	0.33	-0.02
S6	0.57	0.04	S26	0.55	0.03
S7	0.59	0.02	S27	0.47	0.03
S8	0.59	0.28	S28	0.43	0.09
S9	0.67	-0.06	S29	0.51	0.44
S10	0.25	-0.05	S30	0.55	0.34
S11	0.49	0.12	S31	0.43	0.03
S12	0.55	0.27	S32	0.53	0.21
S13	0.61	0.05	S33	0.53	0.30
S14	0.41	0.20	S34	0.41	0.28
S15	0.39	0.20	S35	0.63	-0.13
S16	0.39	0.02	S36	0.45	-0.12
S17	0.37	-0.04	S37	0.53	0.27
S18	0.51	0.43	S38	0.49	0.34
S19	0.59	-0.02	S39	0.45	-0.10
S20	0.33	0.15	S40	0.53	0.24

ANNEX– 3: 18 POSTTEST QUESTIONS

QUESTION 1) In which of the following menu is included the reference geometry in SolidWorks program?

    A) File
    B) Edit
    C) View
    D) Add

QUESTION 2) Which is appropriate to start from on screen to drawing when Sketch is in active mode on Front Plane?

    A) Any part of the screen
    B) In the middle of screen
    C) The intersection points of red arrows on screen
    D) Coordinate plane on lower left corner of screen

QUESTION 3) Which of the following pixels is used to understand if involute curves have properly connected with each other?

    A) Section View
    B) Intersection view
    C) Line view
    D) Center line

QUESTION 4) Which of the following commands remove remaining arcs to make gear profiles made with involute curves visible?

    A) Trim
    B) Mirror
    C) Offset
    D) Convert

QUESTION 5) Which of the following is used for dimensioning in SolidWorks 3d Industrial design program?

    A) Extrude Boss
    B) 3d Sketch
    C) Smart Dimension
    D) Surface

QUESTION 6) Which of the following is used to correct a mistaken dimension in dimensioning?

    A) Delete the dimension
    B) Double click on dimension
    C) Revert with back button
    D) Erase the drawing entirely

QUESTION 7) Which of the following planes is used for 2nd profile while designing a spur gear using front plane to prepare 1st Profile?

    A) Front plane
    B) Top Plane
    C) Right Plane
    D) Bottom Plane

QUESTION 8) Which of the following methods is used to calculate the distance to zoom out the plane to be used for 2nd profile in order to determine the right conical angle for conical gear?

    A) Trigonometry
    B) Pythagorean relation
    C) Derivative
    D) İntegral

QUESTION 9) Which of the following commands is used to draw an arc with known focal point and radius in Sketch section?

    A) Tangent arc
    B) Circle
    C) Spline
    D) Center point Arc

QUESTION 10) How does the gear profile appear when a thread profile is reproduced?

    A) One tooth fill and one tooth spacing
    B) One tooth fill and two teeth spacings
    C) Two teeth fill and one tooth spacing
    D) Two teeth fill and two teeth spacing

QUESTION 11) Which of the following elements do helical and conical angles determine?

    A) Part material
    B) Major thread diameter
   C) Number of threads

D) Minor thread diameter

QUESTION 12) How is the Loft connector determined to generate a helical gear?

A) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear in 2nd Profile.

B) 1st Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on inclined axis in 2nd Profile.

C) 1st Involute Curve of gear in 1st Profile with 1st Involute Curve of gear on inclined axis in 2nd Profile.

D) 2nd Involute Curve of gear in 1st Profile with 2nd Involute Curve of gear on inclined axis in 2nd Profile.

QUESTION 13) How do you verify that a conical gear 3D model has been correctly generated after Loft command?

A) When preview occurs

B) When solid occurs without sketch

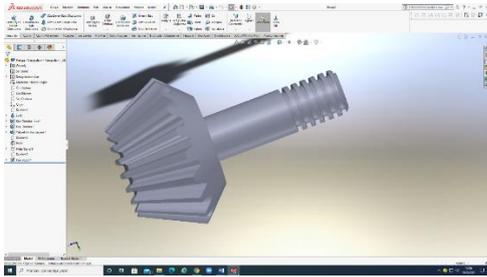C) When solid does not occur

D) When two different bodies occur

QUESTION 14)
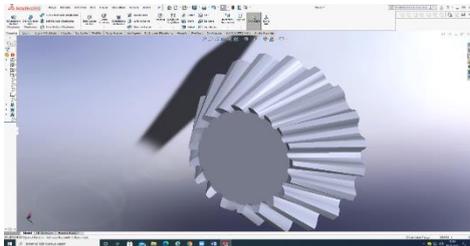
What is the name of the gear shown above?

A) Conical Gear

B) Conical Helical Gear

C) Helical Gear

D) Rack Gear

QUESTION 15)

Which of the following is the screw threaded in arbor part of gear profile shown above?

       A) Triangle right screw

       B) Trapezoid right screw

       C) Square right screw

       D) Trapezoid left screw

QUESTION 16) What is the function of symbol on Extrude toolbar in SolidWorks?

       A) Create solid with extrusion

       B) Cut with extrusion

       C) Create solid with sweep

       D) Create solid with Loft

QUESTION 17) Which of the following information is **wrong** about the grid curves for 3D model design using Loft command**?**

       A) Draw grid curves with spline command.
       B) Grid curves should intersect with all profiles.
       C) There is no limitation on the number of grid curves.
       D) Grid curves may intersect on points.

QUESTION 18)
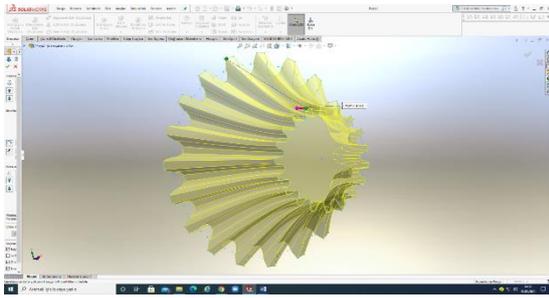
Which of the following is a mistake that causes torque after applying Loft command?

       A) Matrix
       B) Determinant
       C) Spatial deviation
       D) Mass deviation

ANNEX– 4: POSTTEST ITEM ANALYSIS RESULTS OF 18 QUESTIONS

Question No	Item Difficulty Index	Item Discrimination Index
S1	0.43	0.43
S2	0.57	0.26
S3	0.55	0.36
S4	0.57	0.32
S5	0.47	0.23
S6	0.53	0.35
S7	0.43	0.23
S8	0.41	0.30
S9	0.51	0.47
S10	0.43	0.53
S11	0.53	0.34
S12	0.53	0.52
S13	0.57	0.23
S14	0.53	0.34
S15	0.55	0.31
S16	0.43	0.41
S17	0.55	0.36
S18	0.55	0.43

ANNEX– 5: QUESTIONS OF PRACTICAL EXAM

Question 1) How do you open Plan in (Sketch) to design?

Question 2) How do you Create a 2D Profile on Plan Opened?

Question 3) How do you Dimension a Create Profile and Close an Active Drawing?

Question 4) How do you Open a New Plan for Second Profile?

Question 5) How do you Create a Different 2D Profile in Second Plan?

Question 6) How do you Dimension a Second Profile Created and Close and Active Drawing?

Question 7) How do you Create a 3D Model with Loft Command in Extrude Section?

Question 8) How do you Examine Torque Images on Loft Model and Correct any Mistaken Parts?

ANNEX– 6: GRADING KEY FOR PRACTICAL EXAM

PRACTICE QUESTIONS AND PERFORMANCE CRITERIA	Criteria Rating 0- Very Unsuccessful 1- Unsuccessful 2- Average 3- Successful 4- Very Successful				
	0	**1**	**2**	**3**	**4**
Question 1) How do you open a Plan in Sketch to design?	Mark the criteria rating specified				
Criteria for Question 1					
1- *Double clicks on shortcut key on desktop for Solidworks program and selects part design in Program interface on screen and opens drawing screen.*					
2- *Selects front plane from the object tree in drawing screen and switches front plane to eye view direction with normal to tab.*					
3- *Clicks on sketch tab in front plane and centers the origin point on space screen with F key on computer and rotates the screen with mouse to activate the program for design.*					
Question 2) How do you Create a 2D Profile on Plan Opened?	Mark the criteria rating specified				
Criteria for Question 2					
1- *Draws in 2D with free dimension the circles that form thread minor, pitch circle and major threat diameter for helical and conical gear and creates center line by intersecting with circles with center line command on perpendicular axis from the center of circles.*					
2- *Uses center point arc command through pitch circle and creates 1st involute curve from major thread circle up to pitch circle.*					

3- Creates 2nd involute curve with tangent arc command from the intersection point of involute curve with pitch circle up to the minor thread circle.					
Question 3) How do you dimension the profile created and close active drawing?	Mark the criteria rating specified				
Criteria for Question 3					
1- Calculates major, minor diameters, pitch circle and involute curves within the frame of necessary mathematical calculations and dimensions with the smart dimensioning command of the program.					
2- Reproduces such involute curves through mirroring around the center line with mirror command and calculates occurring wheel profile in quantity of wheels and uses circular pattern command and reproduces minor and major thread circles through circular drawing reproduction.					
3- Removes any arc parts in form of remaining drawings inside and outside major and minor thread circles with trim command and removes pitch circle and center lines with delete button and exists from active drawing with close active drawing command.					
Question 4) How do you open a new plan for the second profile?	Mark the criteria rating specified				
Criteria for Question 4					
1- Selects the previous plan and moves on the plan using mouse and presses ctrl button when + mark with arrowhead appears.					
2- Presses the left button of mouse with Ctrl button pressed to scroll the plan.					

3- Calculates with trigonometric calculation by helical angle in helical gear wheel and with Pythagorean relation by conical angle in conical gear wheel as plan scrolling dimension and enters this dimension as plan scrolling dimension and moves the new plan to view direction with normal to tab.					
Question 5) How do you create a different 2D profile on the second plan?	Mark the criteria rating specified				
Criteria for Question 5					
1- Draws inclined, straight lines in proportion to helical angle for helical gear wheel and perpendicular center lines in conical gear wheel starting from the origin point on new plan.					
2- Draws in 2D with circle command at free dimension the circles that create minor thread, pitch circle and major thread diameters for spur gear, helical and conical gear.					
3- Uses center point arc command through Pitch circle from the right side of center lines and creates 1st Involute curve according to the dimension from major thread circle up to pitch circle and creates 2nd Involute curve with tangent arc command according to the dimension from the intersection of Involute curve with pitch circle up to minor thread circle.					
Question 6) How do you dimension a second profile create and close active drawing?	Mark the criteria rating specified				
Criteria for Question 6					
1- Proportions and calculates minor, major thread, pitch circle and involute curves in conical gear to conical angle with Pythagorean relation and dimensions the					

wheel that has been rotated as per helical angle in helical gear with the smart dimensioning command of program.					
2- *Reproduces such occurring involute curves through mirroring around the center line using mirror command and calculates the created wheel profile as much as the number of wheels and uses circular pattern command to reproduce through circular drawing around minor and major thread circles.*					
3- *Uses trim command to remove by trimming the remaining parts of the arc inside and outside minor and major thread circles and removes pitch circle and center lines with delete button and exists from active drawing with close active drawing command.*					
Question 7) How Do you Create a 3D Model with Loft Command in Extrudes Section? **Criteria for Question 7**	Mark the criteria rating specified				
1- *Examines 2 separate profiles with active drawing closed and presses create a solid button with Loft in Extrude section and clicks separately once on vertex major thread arc of 1st wheel module in 1st profile for spur gear and on vertex major thread arc of 1st wheel module in 2nd profile.*					
2- *Clicks separately once on vertex major thread arc of 1st wheel module in 1st Profile for helical gear and on vertex major thread arc of wheel module on helical axis in 2nd profile.*					
3- *Clicks separately once on vertex major thread arc of 1st wheel module in 1st profile for conical gear and on vertex major thread arc of 1st wheel module on conical axis in 2nd profile.*					

4- Waits for the computer to perform necessary matrix and determinant calculations and examines 3D sketch in yellow color and returns to design screen in case of any mistaken views.					
Question 8) How do you examine torque image on Loft Model create and correct any mistaken parts?	Mark the criteria rating specified				
Criteria for Question 8					
1- Examines the sketch created after linking the profile with Loft command by scrolling the mouse and checks for the position of reference points in torque image.					
2- Symmetrically aligns green reference points that are asymmetrically positioned and cause an obvious distortion in the profile and checks for any distortions in profile after aligning and confirms Loft command.					
3- Opens render menu about solid model created after Loft and arranges the stage.					
Column totals of scores according to the criteria specified in Performance Indexes					
Overall Success Grade out of 100 (Grand Total of Criteria Columns)					