

# UNITEL

**M1 – 2**

**UNITEL Project survey analysis using advanced statistical and data mining methods: current state, state-of-the-art, and future perspective**

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# Topics

- Pedagogical concepts used in the design of the WP1 questionnaire
- Pedagogy for technology-enhanced learning
- The ACRS model
- Reliability, and validity in survey analysis
- Data mining and statistical analysis of surveys
- Survey analysis results of Iranian Universities
- Pedagogical concepts in Iranian universities and the state-of-the-art
- The limitations of current pedagogical concepts and future activity

# Objectives

- The objectives of the lesson are:
  - Understand the pedagogical concepts used to design the UNITEL Project survey (WP1)
  - Understand the methods used to assess the validity and reliability of questionnaires
  - Discuss the reliability of the WP1 questionnaire
  - Understand how to extract higher-level information from the WP1 questionnaire using statistical and data mining methods
  - Discuss the limitations and future activity of current pedagogical concepts of the courses presented in Iranian universities, compared to the state-of-the-art.

# The WP1 questionnaire

- Students' Questionnaire:
  - Theory and practice
  - Self-regulation and motivation
  - Knowledge, skills, and attitudes
  - Working-life orientation
  - pedagogy for technology-enhanced learning and culture of teaching
  - Assessment
- Faculty members' Questionnaire:
  - Theory and practice
  - Self-regulation and motivation
  - Knowledge, skills, and attitudes
- Companies and Business Actors

Practice refers to the actual observation, operation, or experiment.

Self-regulation is the ability to monitor and manage energy states, emotions, thoughts, and behaviors in ways that are acceptable and produce positive results such as well-being, loving relationships, and learning.

Students who are motivated to reach a certain goal will engage in self-regulatory activities they feel will help them achieve that goal.

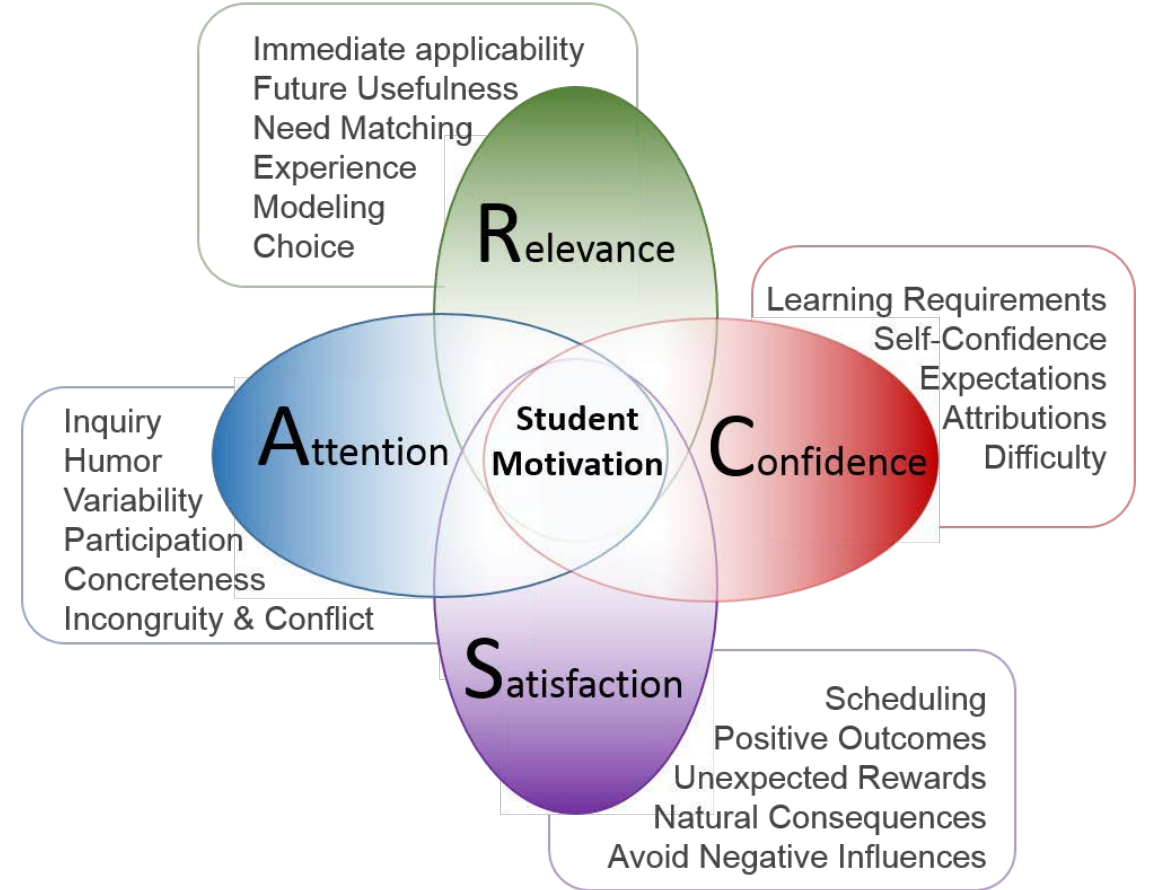
These questions help to know "how TEL help to enhance students' skills".

Soft skills are a combination of people skills, social skills, communication skills, character or personality traits, attitudes, mindsets, career attributes, social intelligence and emotional intelligence quotients, among others, that enable people to navigate their environment, work well with others, perform well.

Hard skills are abilities that let people tackle job-specific duties and responsibilities. Hard skills can be learned through courses, vocational training, and on the job.

# The ARCS model

Attention	Relevance	Confidence	Satisfaction
<b>Perceptual arousal</b>  Provide novelty and surprise	<b>Goal orientation</b>  Present objectives and useful purpose of instruction and specific methods for successful achievement	<b>Learning requirements</b>  Inform students about learning and performance requirements and assessment criteria	<b>Intrinsic reinforcement</b>  Encourage and support intrinsic enjoyment of the learning experience
<b>Inquiry arousal</b>  Stimulate curiosity by posing questions or problems to solve	<b>Motive matching</b>  Match objectives to student needs and motives	<b>Successful opportunities</b>  Provide challenging and meaningful opportunities for successful learning	<b>Extrinsic rewards</b>  Provide positive reinforcement and motivational feedback
<b>Variability</b>  Incorporate a range of methods and media to meet students' varying needs	<b>Familiarity</b>  Present content in ways that are understandable and that related to the learners' experiences and values	<b>Personal responsibility</b>  Link learning success to students' personal effort and ability	<b>Equity</b>  Maintain consistent standards and consequences for success



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 from Wikimedia Commons;  
<https://pressbooks.bccampus.ca/arcanddl/chapter/chapter-1/>

Serhat Kurt, "Model of Motivation: ARCS Instructional Design,"  
<https://educationlibrary.org/model-of-motivation-arcs-instructional-design/>,  
 Access Date: 8/16/2022

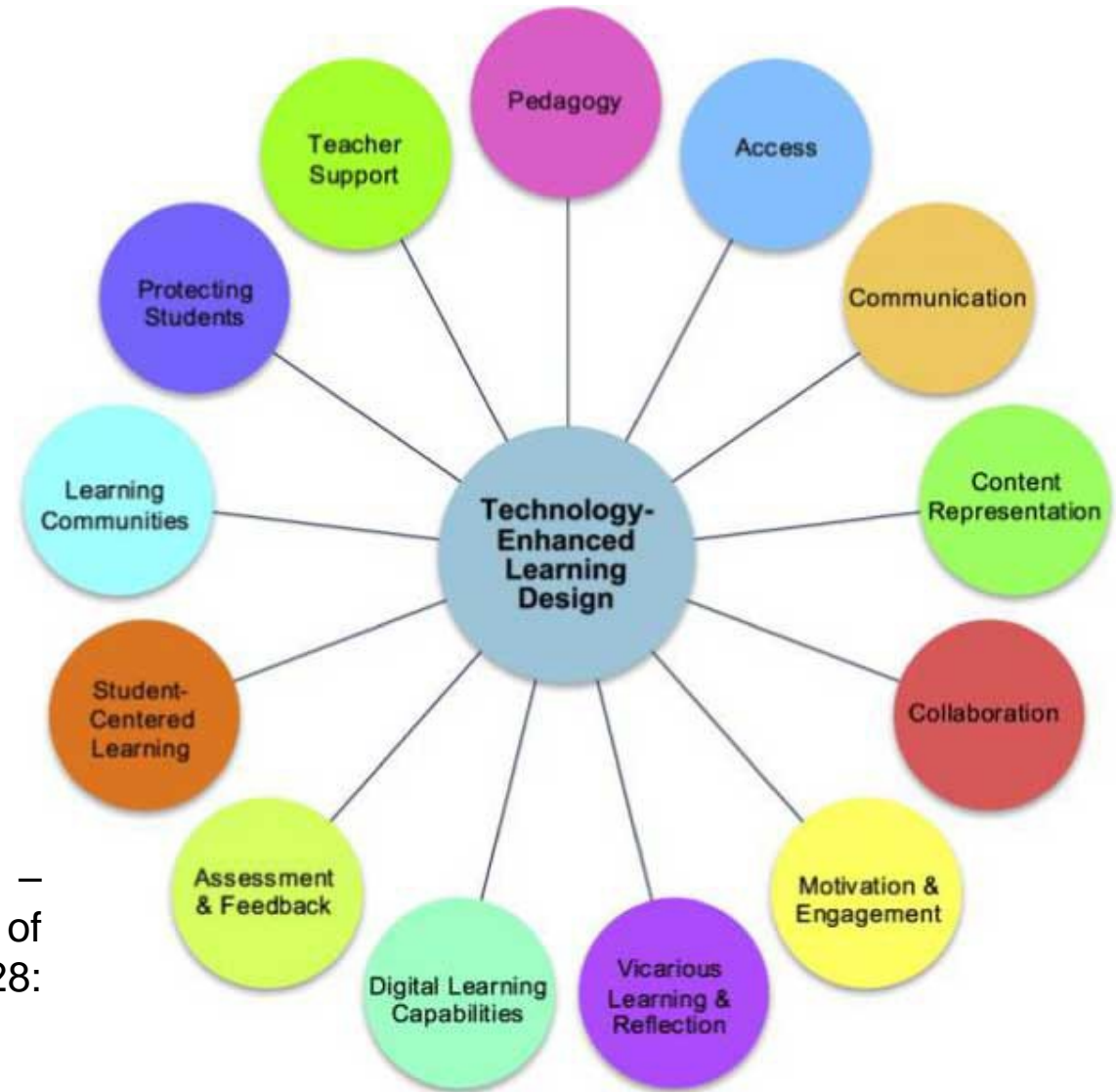
L. Laurens-Arredondo, "Mobile augmented reality adapted to the ARCS model of motivation: a case study during the COVID-19 pandemic," *Education and Information Technologies*, 2022/02/26, 2022.

# Technology-enhanced learning (TEL)

- ✓ Using of technology and the Internet
- ✓ The support of teaching and learning  
Using of technology
- ✓ Providing socio-technical innovations  
for learning practices

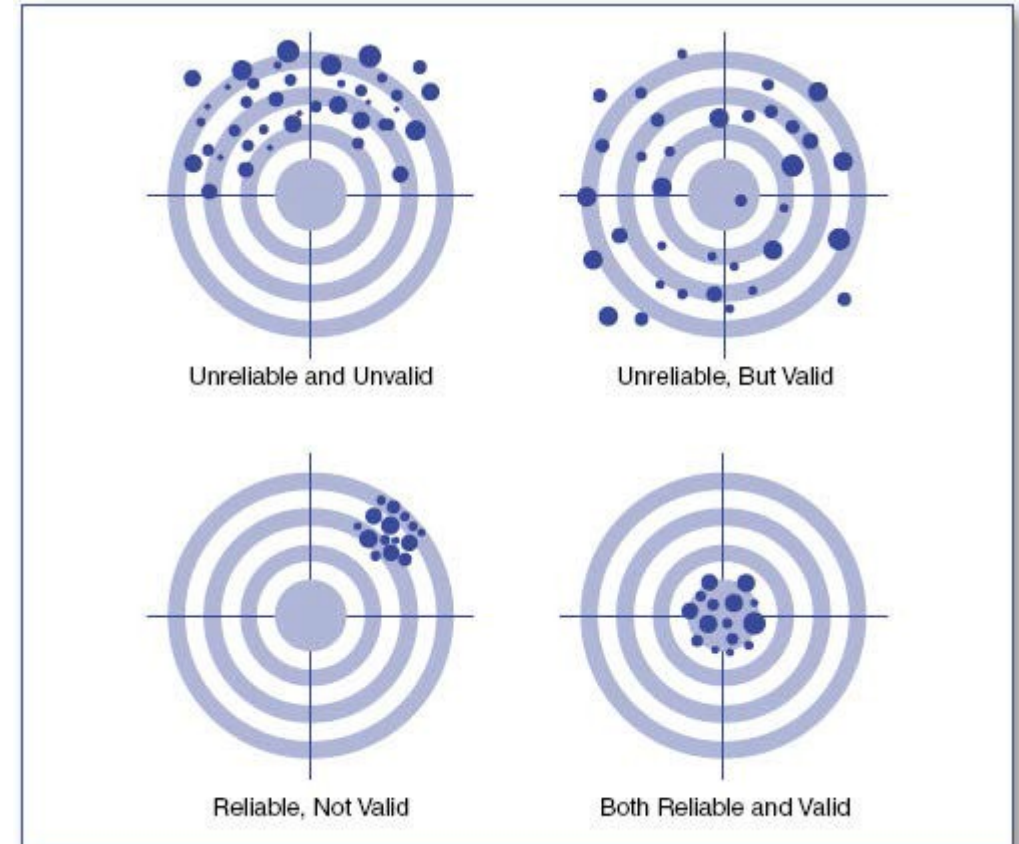
Technology Enhanced Learning (TEL) is the implementation of technology into teaching methods to enhance the learning process.

M. Bower, "Technology-Enhanced Learning – Conclusions and Future Directions," Design of Technology-Enhanced Learning, pp. 405-428: Emerald Publishing Limited, 2017.



# Survey analysis

- Reliability
  - Test-retest reliability
  - Inter-rater reliability
  - Parallel-form reliability
  - Split-half reliability
  - Internal consistency
- Validity
  - Face validity
  - Content validity
  - Criterion validity
  - Concurrent validity
  - Construct validity



E. Ruel, W. E. Wagner, III, and B. J. Gillespie, "The Practice of Survey Research: Theory and Applications," SAGE Publications, Inc, 2016.

M. Litwin, "How to Measure Survey Reliability and Validity," 1995.

# Statistical summary measure of the consistency of the WP1 Survey

Samples	Items	N	Cronbach's Alpha	CI 95%	ANOVA, Tukey's test for non-additivity	Hotelling's $t^2$ test
Faculty members	35	87	0.765	[0.688,0.831]	$P < 0.001$	$P < 0.001$
University students	42	96	0.890	[0.857,0.920]	$P < 0.001$	$P < 0.001$

- ✓ Likert scale items were used.
- ✓ Questions with high percentage of missing were deleted.
- ✓ Deleting some Questionnaires did not improve the consistency.

## Conclusion:

Items in the scale measure **different sub-dimensions** and that the items of the scale are **summable**. The student's survey is **reliable** but the faculty member's survey is **marginally reliable**.



# Clustering of confirmatory factor analysis (FA)

**Students' survey:**

**Number of Factors: 15**

**Rotation Method: Varimax**

**Clustering method: Two-step**

**Validation: AIC**

**Number of clusters: One**

**Faculty member's survey:**

**Based on KMO,**

No FA and also clustering  
Were performed.

**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.725
Bartlett's Test of Sphericity	Approx. Chi-Square	1803.541
	df	861
	Sig.	.000

**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.495
Bartlett's Test of Sphericity	Approx. Chi-Square	1053.238
	df	630
	Sig.	.000

The **Kaiser-Meyer-Olkin (KMO) Test** is a measure of how suited the data is for Factor Analysis.

The **Bartlett's test** provides probability that the correlation matrix has significant correlations among at least some of the variables in a dataset, a prerequisite for factor analysis to work.

KMO measure	Interpretation
$KMO \geq 0.90$	Marvelous
$0.80 \leq KMO < 0.90$	Meritorious
$0.70 \leq KMO < 0.80$	Average
$0.60 \leq KMO < 0.70$	Mediocre
$0.50 \leq KMO < 0.60$	Terrible
$KMO < 0.50$	Unacceptable

# Limitation of the learning methods during pandemic

- Using **One-sample Wilcoxon Signed Rank Test**, we analyzed the limitation of the current “**emergency online teaching**”:

Students' questionnaire item	Result	Significance
Hands-on experiences and practical actions important for training engineers are <b>possible</b> in an online learning environment.	Major Negative	$P < 0.001$
Videos of experiments, research papers and study design exercises, and experimental data provided for analysis and interpretation could be a good alternative for practical action.	Major Negative	$P < 0.001$
TEL changes the role of the student (before I was an information receiver, and now I build my own knowledge)	Major Negative	$P = 0.002$
My motivation in online education is <b>lower</b> compared to face-to-face classes.	Major Positive	$P < 0.001$

# Key obstacles in Emergency online learning

- Finding coursework's challenging
- The availability of the course instructors
- Interaction with classmates
- Missing course announcement
- Understanding learning goals
- Self-discipline in online environment
- Academic misconduct

As an educator or aspiring teacher, it is important not only to understand and empathize with the challenges of online education for students – but even more critically, to help implement effective solutions.

online learning presents a learning environment that is distinct from face-to-face or classroom learning environments.

Broadly identified challenges with e-learning are accessibility, affordability, flexibility, learning pedagogy, life-long learning and educational policy

D. J. Lemay, P. Bazelais, and T. Doleck, “Transition to online learning during the COVID-19 pandemic,” *Computers in Human Behavior Reports*, vol. 4, pp. 100130, 2021/08/01/, 2021.

# Key obstacles Cont'd

## Themes and subthemes obtained from the interview

Primary concepts	Subthemes	Themes
Lack of planning for the presentation of course content by faculty	Not familiar with virtual education	Students' concerns
Nonstandard content	Academic delay	
Low opportunity for questions and answers	Content challenge	Obstacles to the training process
Poor response	Interaction defects	
Prolonged feedback time from faculty	Inappropriate online testing method	Weakness of technology
Impossibility to go back in questions	Lack of access to smart virtual communication devices	
Difficulty of tests	Insufficiency of the Internet platform	
Allocate low time to questions	Elimination of time and place limitations of learning	
	Possibility to listen to audio file several times	Flexibility of asynchronous virtual education
	Independence in learning	

R. Sodeify, Z. Habibpour, and M. Akbarbegloo, "Explaining medical students' perceptions of asynchronous virtual education in the COVID-19 pandemic: A qualitative study," Journal of education and health promotion, 11, <http://europepmc.org/abstract/MED/35677257>

# Key obstacles Cont'd

- ✓ Difficulties related to student-student interactions
- ✓ Difficulties with self-regulated learning
- ✓ Difficulties related to student-faculty interactions
- ✓ Technical difficulties
- ✓ Belief that learning became less effective during distance learning
- ✓ Satisfaction with the way distance learning was organized at university

R. Y. Chan, K. Bista, and R. M. Allen, Online teaching and learning in higher education during COVID-19: International perspectives and experiences: Routledge, 2021.

# Action Plan

## Proper E-learning curriculum, virtual , Remote lab design

1. Proper course validation
2. The application of e-learning material in Flipped classroom
3. Using Various methods, including Project-Based and Collaborative Learning

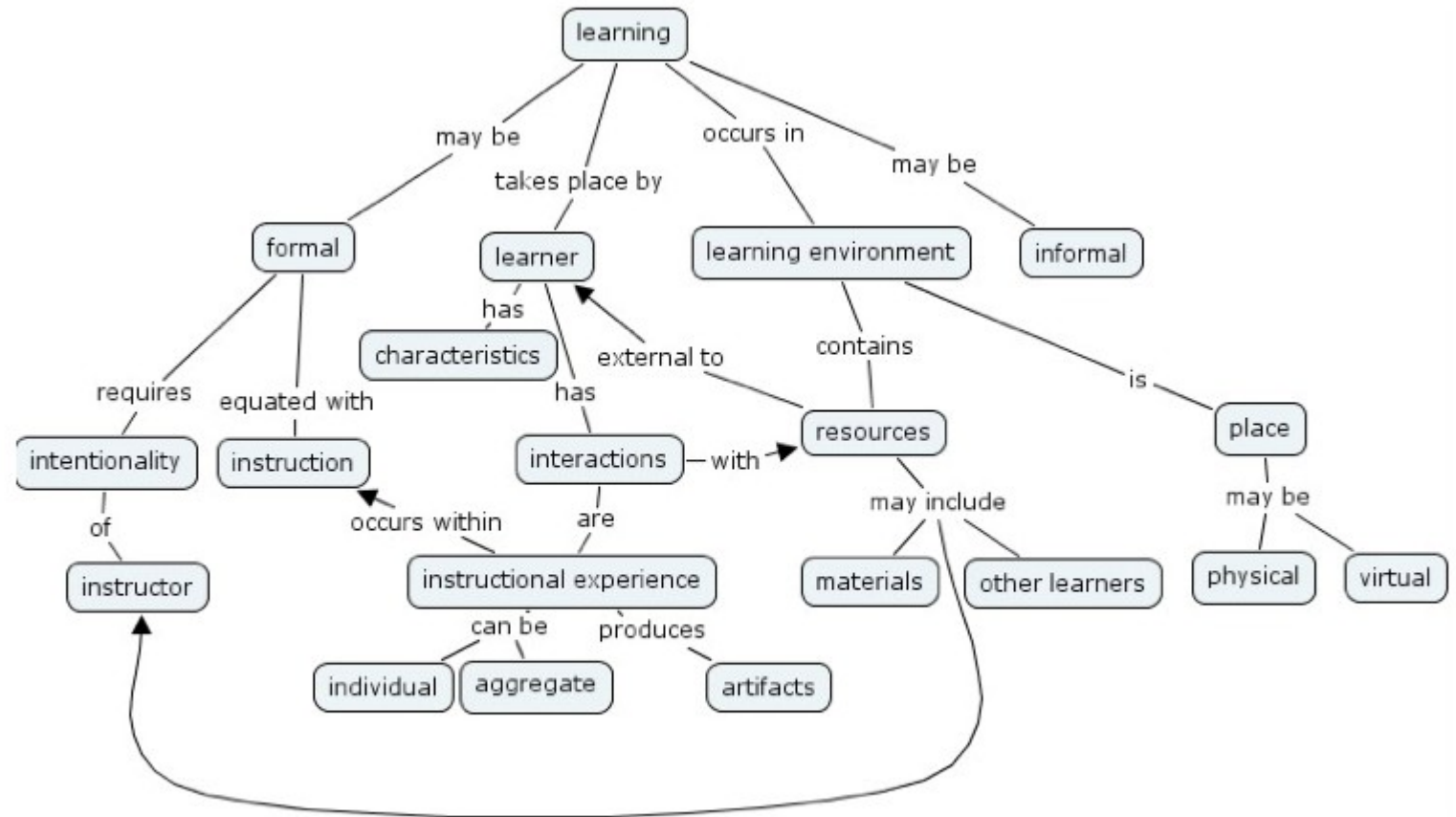


Figure 4. Concepts Underlying Learning

K. Thompson, Constructing educational criticism of online courses:

A model for implementation by practitioners: University of Central Florida, 2005.

## A case study by Marateb *et al.* 2022

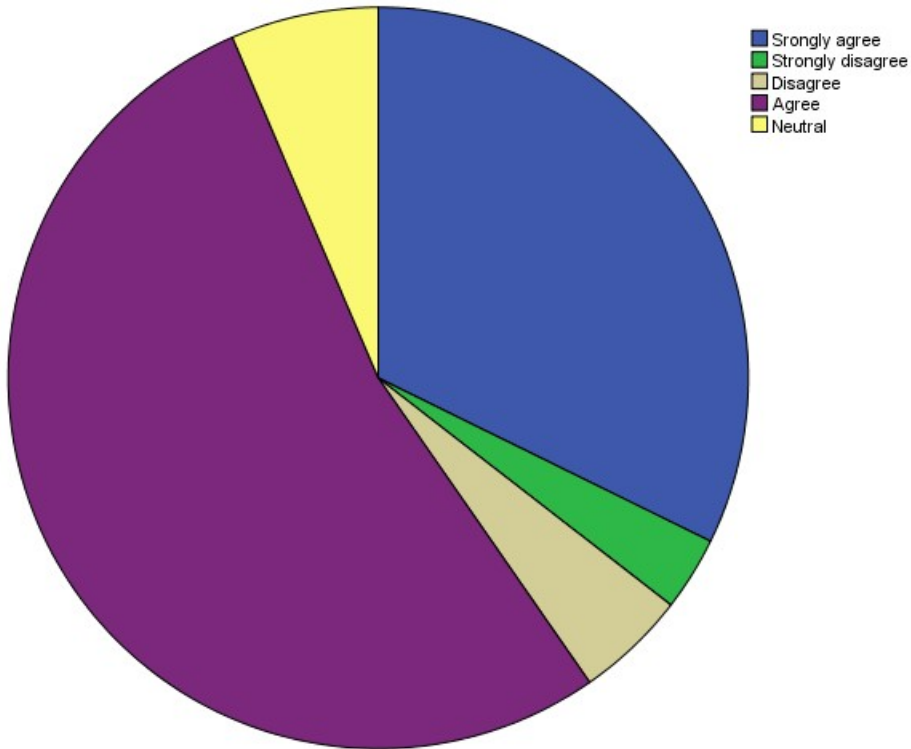
- Flipped classroom was provided in undergraduate and graduate courses (B.Sc., M.Sc., and Ph.D. Of Biomedical Engineering) by a faulty member
- Signal processing, Nonlinear Optimization, Bio-statistics, and medical data mining courses
- Various methods (PBL, CL, etc.) were implemented
- The reliability of the questionnaire was assessed.
- Main results: Proper e-learning material could be used in blended learning

Samples	Items	N	Cronbach's Alpha	CI 95%	ANOVA, Tukey's test for non-additivity	Hotelling's $t^2$ test
BME students	21	59	0.760	[0.661,0.840]	$P < 0.001$	$P < 0.001$

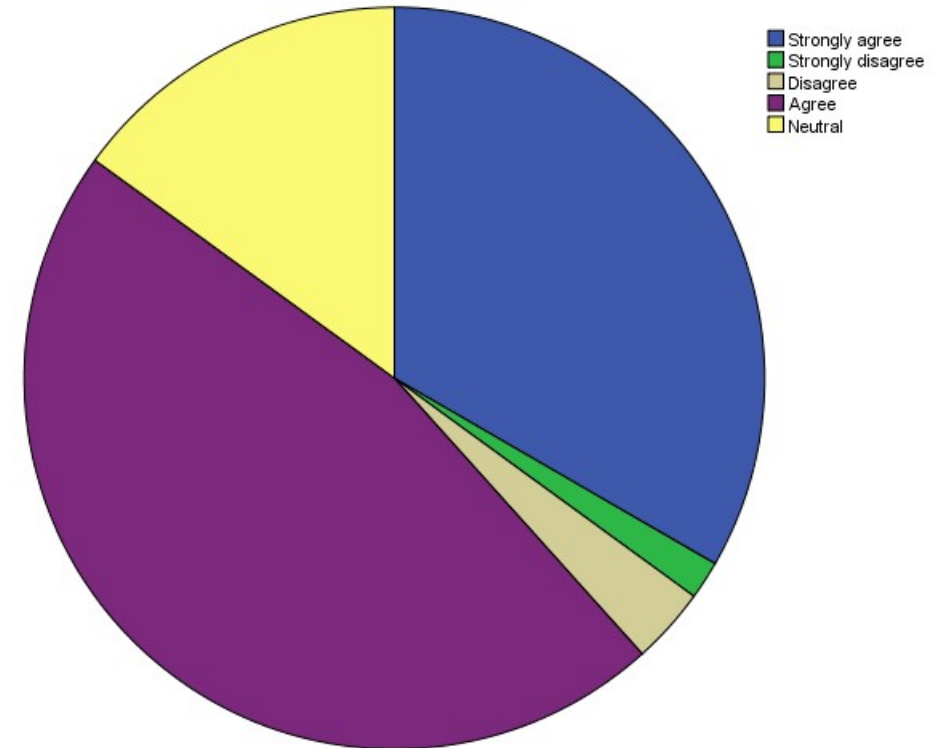
Items in the scale measure **different sub-dimensions** and that the items of the scale are **summable**. The student's survey is **marginally reliable**.

## The case study, Cont'd

The Flipped classroom is **more engaging** than traditional classroom instruction.



I am **more motivated** to learn Engineering or science course in the Flipped Classroom.





# The case study, Cont'd

- Using **One-sample Wilcoxon Signed Rank Test**, we analyzed the application of the "**Flipped Classroom**":

Students' questionnaire item	Result	Significance
I would rather watch a <b>traditional teacher lesson</b> than a lesson video.	Major Negative	$P < 0.001$
The Flipped classroom gives me more time to perform <b>laboratory activities</b> in class.	Major Positive	$P < 0.001$
The Flipped classroom gives me more class time to <b>practice</b> problems.	Major Positive	$P < 0.001$
The Flipped classroom gives me greater opportunities to <b>communicate</b> with other students.	Major Positive	$P < 0.001$

# Conclusions

1. Proper survey analysis is important for policy-making.

Survey research is sometimes regarded as an easy research approach. However, as with any other research approach and method, it is easy to conduct a survey of poor quality rather than one of high quality and real value.

2. Some statistical methods are required for such a validation.

Statistical validity can be defined as the extent to which drawn conclusions of a research study can be considered accurate and reliable from a statistical test. To achieve statistical validity, it is essential for researchers to have sufficient data and also choose the right statistical approach to analyze that data.

3. Emergency online teaching leads to various learning problems.

4. Proper e-learning is required for pandemics.

5. Virtual and Remote labs must be provided for Science and Technology courses.

6. Such materials are also useful in Flipped classroom.