J-DSP in Digital Signal Processing Course

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Assessment Results

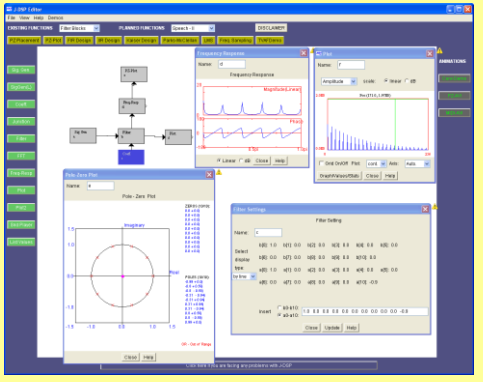
J-DSP

- J-DSP provides
  - an interactive graphical user interface,
  - Easy visualization of the signal flow and the transformations that occur from input to the output stages.
  - Since each block represents a functional abstraction of the concepts directly.
  - No programming experience is required to simulate or experiment several DSP concepts.
  - Students can directly experiment with their acquired classroom knowledge in J-DSP environment.
- Students can learn DSP concepts without having to worry about learning the syntax of a programming language.
- Provides an "MATLAB Script export" functionality which later helps students to recreate their simulations in MATLAB.

Example Laboratories

- Convolution,
- Z- Transforms and Frequency Response,
- FIR and IIR filter design,
- Fast Fourier Transform,
- Multirate Signal Processing.

Example Simulation



Assessment

- General Assessment :
  - To assess the simplicity and interactivity of J-DSP environment
  - Effectiveness in teaching DSP concepts
  - Improvement in average student scores after using J-DSP
  - Effectiveness in teaching distance learners.
- Concept-Specific Assessment:
  - To determine the extent of student learning using J-DSP online laboratories.

General Assessment Results

RESULTS:

- 95% of students liked the concept of internet based simulations.
- 70% of students responded that it took them less than 30 minutes to get familiarized with the J-DSP environment.
- 85.5% students agreed that they would consider using J-DSP for constructing their own educational simulations.

General Assessment Results

Evaluation Questions	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Establishing and connecting blocks is easy	53	39	7	1	0
The graphical interface of J-DSP is intuitive and user-friendly	31	63	5	1	0
In my opinion, this (J-DSP) type of on-line lab concept is beneficial for distance learning	97 (Yes)		-		3 (No)
I would consider J-DSP for small simulations apart from the lab exercises	86 (Yes)		-		14 (No)
With the help of a simple manual, it is possible to learn the basics of DSP by using J-DSP	86 (Yes)		-		14 (No)
The J-DSP should be established as a full-fledged tool	93 (Yes)		-		7 (No)
How long did it take to get familiar with the basics of the J-DSP environment	< 15 min : 36 %		15-30 min : 32 %		
	30-60 min : 24%		> 60 min : 8%		

Concept-Specific Assessment Results

RESULTS:

1. Z-transform exercises:
   - Students understood relationship between *impulse response*, *frequency response* and *z-transform* properties.
   - 91% of students responded that they understood the relationship between pole-zero placement and frequency response plots.
2. Filter Design exercises:
   - Students understood FIR and IIR Filter design concepts including *linear phase*, tradeoff between *transition characteristics* with *window type*.
   - 87% of students reported that they understood which window is suitable for sharp transitions.
3. FFT exercises:
   - FFT properties such as *signal symmetry*, *spectral resolution*, *window effects* were understood easily with J-DSP environment.
   - 88% of students responded that they understood signal symmetries in the FFT domain.

Concept-Specific Assessment Results

Evaluation Questions	Strongly Agree	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree
The J-DSP on-line labs helped me to understand the concepts of the z-transform	50	46	3	1	0
My understanding of the concepts of FIR and IIR filter design is enhanced by the J-DSP labs	42	47	8	3	0
The general concepts of using FFT in signal analysis is clear by performing a J-DSP simulation	24	61	13	2	0
I have learned how to generate a sinusoid with a digital filter	29	55	11	3	2
Enough information is available on the help screens and the dialog windows.	49		33.5	13.5	
The relationship between the impulse response and the transfer function is clear	95 (Yes)		-		5 (No)
After performing the J-DSP lab it is clear that the FFT spectral resolution is limited by the FFT size, the window type, and the window size	99 (Yes)		-		1 (No)
J-DSP labs enhanced my learning of the basic DSP concepts (Labs 1-4 average statistics)	92 (Yes)		-		8 (No)

Pre/Post Lab Assessments

- J-DSP Labs 2,3 and 5 resulted in significant improvements of 13.5, 9.5 and 12 points in their average RAW Score. [See Table below]

J-DSP Lab Number	Number of subtests or questions in each lab	Average raw score [MAX = 100]		
		Pre-lab	Post-lab	Improvement in the raw score
1	6	78.75	83.5	4.75
2	5	62.0	75.5	13.5
3	10	50.0	59.5	9.5
4	4	61.25	65.0	3.75
5	4	47.5	59.5	12.0

- The improvement can be attributed to
  - Simulations involving Interactive graphics.
- The assessments were also helpful in redesigning some lab exercises.

Statistical Analysis - Effect size

The Effect Size (ES) measure:

- It is the ratio of the difference in means to the pooled standard deviation.

Effect size: $d = \frac{\mu_2 - \mu_1}{\sigma_{pooled}}$

where $\sigma_{pooled} = \sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}$

The Effect Size (ES) Correlation measure:

- The ES correlation, *r*, measures the degree to which the pre-lab and the post-lab assessment data are related

ES Correlation $r = \frac{d}{\sqrt{d^2 + 4}}$

The Effect Size (ES) measure:

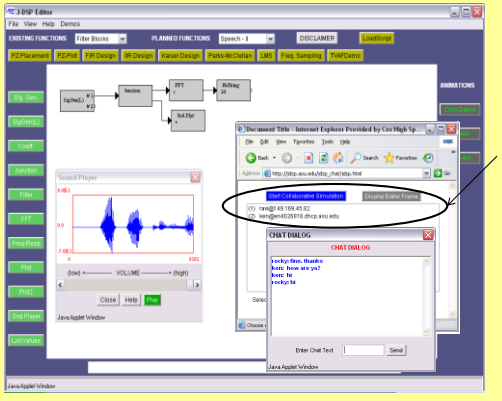
- The ES measure gives valuable information on how strong the effect of involvement was.
- Here, it corresponds to degree of student learning attributed to J-DSP.

Statistical Analysis

J-DSP Lab Number	Mean score		Standard deviation		Effect size	Correlation coefficient
	Pre-lab	Post-lab	Pre-lab	Post-lab		
1	78.75	83.5	16.41	15.05	0.302 (Medium)	0.149
2	62.0	75.5	16.98	11.84	0.922 (Large)	0.419
3	50.0	59.5	21.1	20.39	0.458 (Medium)	0.223
4	61.25	65.0	30.9	34.20	0.115 (Small)	0.057
5	47.5	59.5	9.72	12.50	1.072 (Large)	0.472

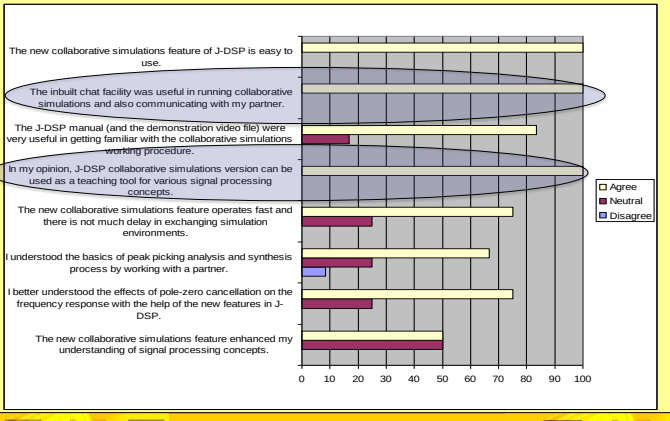
- In general, ES values of 0.2, 0.5, and 0.8 relate to 'small', 'medium', and 'large' degree of involvement, respectively .
- J-DSP labs 2, 3, and 5 resulted in ES of 0.92, 0.46, and 1.07, respectively.
- This result is consistent with the pre/post lab assessment results.

Collaborative Simulations

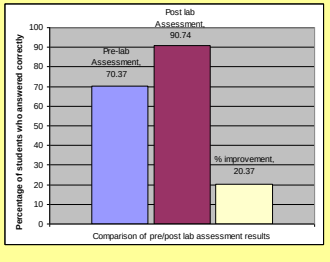


Select a user and click on the '*Start Collaborative Simulation*' Button

Collaborative Environment



Assessment Results



- Useful for the instructors to teach online students.
- Students can learn collaboratively particularly when they are from remote locations.

THANK YOU