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HUMAN-TECHNOLOGY INTERACTION AND THE STUDENTS OF ENGINEERING: A PERCEPTION-BASED ANALYSIS

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Abstract

Human-Technology Interaction encompasses how individuals interact with and use technology in various aspects of their lives. Humans and technology are deeply interconnected and are mutually influenced. Centers on HTI have been established in universities world over and they are investigating how effectively humans could engage with technology. The Students of Engineering and Technology programs, who are the current consumers of technology and future creators of it, are expected to have a clear perception of the nature of technology. They should also develop a good understanding of how technology interacts with humans. The paper aims to create awareness on HTI among the budding engineers. This study showcases the findings of a Perception Analysis Survey conducted among the students of various branches of engineering and technology. The methodology, the statistical analysis, results and findings of the study are presented in the paper. The study gives a positive note that the Engineering Students have an adequate understanding of the concept of HTI.

Keywords: Human-Technology Interaction, Perception Analysis, Engineering Students.

1. INTRODUCTION

Human-Technology Interaction (HTI) refers to the interaction between humans and technology, encompassing how people interact with and use technology in various aspects of their lives. It involves both physical and cognitive aspects of interaction, such as using devices and interfaces, as well as interpreting and making decisions based on technology. HTI has a significant impact on human behavior, cognition, and social dynamics. It focuses on understanding the cognitive mechanism of how humans interact with intelligent technologies and automation systems.

HTI explores the relation between humans and machines to illustrate how interface design could address the human limitations, shape social interactions and provide ecological implications. The origin of HTI denotes a significant transpose in technology design; it gives importance to human experiences, capabilities, and predilection. Its main aim is to bridge the gap between humans and technology, specifically technology seems to be more accessible, intuitive, and aligned with our needs and desires.

The field of HTI also takes into account the social, cultural, and ethical ramifications of technology utilization. It investigates how technology influences social dynamics, communication norms, privacy concerns, and ethical considerations. It delves into matters like the digital divide, accessibility, biases in algorithms, and the border societal effects of technology. This is a rapidly emerging area of research because of the increasing importance of technology in our daily lives. Scientists and engineers focus their area of research on the design, use, adaptation and influence of technologies on people and societies.

In the discipline of HTI, studies have been done in distinct areas like how users perceive, interact with, and experience technology, with a focus on improving the design and usability of digital interfaces, websites, mobile apps, and other software. In Human-AI Interaction, researchers are delving into the way humans connect with and trust artificial intelligence systems, as well as how to improve communication and collaboration between humans and AI. In Human-Robot Interaction, researchers are exploring how robots and humans can interact effectively, from assistive robots in healthcare to social robots in various contexts.

The HTI group at Eindhoven University of Technology conducts research to discover how a person interacts with technology and learn, aspiring to gain a deeper understanding and to enhance the compatibility between technological mechanism and its users (1). The group concentrates mainly on social and cognitive psychology and their goal seems to investigate how effectively humans could engage with technology. The HTI Lab of PennState College of Engineering, USA, strives to figure out the human-system interactions in transportation and healthcare domains. They conduct research on understanding the impact of automation technology on humans' decision-making, trust, situation awareness, and adaptive behaviors (2). Human-Technology Interaction equips students with the essential knowledge and skills to assess the practicality of emerging technological advancements considering human values, objectives, limitations, and abilities.

2. HTI: SOME PERSPECTIVES

There are three philosophical perspectives present in HTI such as technology as an autonomous force that determines society, technology as a human construct that can be shaped by human values, and a co-evolutionary perspective on technology and society where neither of them determines the other (3). Each perspective comes with certain core assumptions that define certain development as threats, and others as opportunities.

3. STATUS OF THE LITERATURE

The review of literature was made on the available literature in this area. Research done on “Effects of human–machine interaction on employee’s learning: A contingent perspective” (4), concentrate more on the impact of human–machine interaction on employees at the initial stage of AI development, and the level of machine intelligence in various industries will reach a high degree of autonomy in the future. The second article titled “Questionnaires to Measure Acceptability of Social Robots: A Critical Review” (5), describes psychometrically validated questionnaire design to assess factors of social acceptability with social robots. “Survey Research in HCI” (6) explores various uses of surveys in HCI such as gathering information about people’s habits, interaction with technology or behavior.

“Attitudes and perception of artificial intelligence in healthcare: A cross-sectional survey among Patients” (7) gave the results of a survey conducted on 452 German patients on artificial intelligence (AI) in healthcare. Despite a moderate understanding of AI, a majority (53.18%) viewed its application in medicine positively. Only 4.77% expressed a negative opinion. An article titled, “The Media and Technology Usage and Attitudes Scale: An empirical investigation” (8) analyzed the positive, pessimistic attitudes, technological dependence/anxiety, and views toward task-switching among

942 participants. These researches give us a fairly good idea on the perception-based surveys conducted on Human Technology Interaction and its allied areas.

4. OBJECTIVES OF THE STUDY

- To assess the Perception of Engineering Students' on Human-Technology Interaction
- To find the general awareness on Human-Technology Interaction among the undergraduate Engineering students.
- To identify the positive attitude of undergraduate Engineering students on Human-Technology Interaction.
- To determine the negative attitude on Human-Technology Interaction of undergraduate Engineering students.
- To ascertain the technology dependence of undergraduate Engineering students on Human- Technology Interaction.
- To find the understanding of the philosophical perspectives on the relation between the technology and society by the undergraduate Engineering students.

5. METHODOLOGY

Survey details: We carried out a survey among the undergraduate engineering students of various branches of SASTRA Deemed University, Thanjavur, India, to ascertain their perception of Human Technology Interaction. The survey questionnaire was distributed as a Google form. However, the first author explained the concept of HTI and the objectives of the survey to the students in the classes prior to their responses. Tool description: A questionnaire for the survey was constructed with 30 close-ended questions with five-point scale. The questions were classified into five different domains namely General Awareness on HTI, Positive Attitudes, Negative Attitudes, Technology Dependence and Philosophical Perspectives on the relation between technology and society. Method of collection: 82 responses were received out of which (53.2%) 44 are from the 1st year, (39%) 32 are from the 2nd year and (9.8%) 8 are from the 3rd year classes of the four-year undergraduate programme. Regarding the gender ratio, the male samples comprised (53.7%) and the female samples 42.7%.

5.1. Hypothesis of the Study

H1: There is no difference in general awareness on HTI among the undergraduate students across the year of study and between the genders.

H2: There is no difference in positive attitude on HTI among the undergraduate students across the year of study and between the genders.

H3: There is no difference in negative attitude on HTI among the undergraduate students across the year of study and between the genders.

H4: There is no difference in technology dependence on HTI among the undergraduate students across the year of study and between the genders.

H5: There is no difference in philosophical perspective on HTI among the undergraduate students across the year of study and between the genders.

H6: There is no difference in Perception on HTI (overall) among the undergraduate students across the year of study and between the genders.

5.2. Non-Parametric Tests

A T-test was done on the available data, using the SPSS software. A t-test is used to determine if there is a difference between the means of two groups. The t-test is especially beneficial when dealing with limited sample size. It is divided into two types such as Independent Sample t-test (comparing the means of two independent groups) and Paired Sample t-test (comparing the means of two related groups). We have tested the samples in Independent Sample t-test. We have also tested the samples in The Mann-Whitney U test, known as the Wilcoxon rank-sum test which is a non-parametric statistical test used to assess whether there is a significant difference between two independent groups. The Mann-Whitney U test, differentiates between two individual groups when the dependent variable is either ordinal or continuous, but not normally distributed and it is very useful for the researchers to find out the values.

6. RESULTS AND FINDINGS

6.1 Mean, Standard Deviation

Table 1: Mean, Standard Deviation

Components	Gender	N	Mean	Std. Deviation
General Awareness	Female	47	8.7447	0.79312
	Male	35	8.7143	1.20224
Positive Attitudes	Female	47	29.1915	2.95354
	Male	35	27.8857	3.83307
Negative Attitudes	Female	47	38.1489	6.79507
	Male	35	36.1714	6.50559
Technology Dependence	Female	47	8.1064	1.61829
	Male	35	7.4286	1.80336
Philosophical Perspectives	Female	47	35.8723	3.90438
	Male	35	35.0000	5.03517
Perception on HTI	Female	47	101.0426	5.38903
	Male	35	99.1429	8.06643

This study helps us to know the Perception on Human-Technology Interaction among the engineering students. In the analysis, we discover that the mean value for each sub-scales, coming under the general awareness, the mean value for female is 8.7447 and male is 8.7143.The standard deviation pertaining to the male is 1.20224 and as well as female is 0.79312. There is no much difference between the mean differences of male and female under the general awareness component. In positive attitudes component, we identified that the mean value for female is 29.1915 and male is 27.8857. And also, the standard deviation with regard to the male is 3.83307 and female is 2.95354. In negative attitudes component, we found that the mean value for male is 36.1714 and female is 38.1489. We found that the standard deviation pertaining to the male is 6.50559, and female is 6.79507. So, there is no much difference between the mean and standard deviation of male and female under the negative attitudes component. In technology dependence, the mean value for male is found to be 7.4286 and female is 8.1064. And also the standard deviation pertaining to the male is 1.80336 and female is 1.61829. Here, also there is no difference between mean and standard deviation. In Philosophical perspectives component, the mean vale for female stands at 35.8723 and male is 35.0000. We detected that the

standard deviation pertaining to the male is 5.03517 and female is 3.90438. Finally, we found out that there is no much difference between mean and standard deviation. So, we have gone for the Mann-Whitney U-test to find if there is any significant difference.

Table 2: Perception on HTI of undergraduate Engineering Students

N	Minimum	Maximum	Mean	Standard Deviation
82	90	150	117.988	12.8989

Table 2 shows the 82 observations ranging from a minimum of 90 to a maximum of 150, with an average (mean) of 117.988 and a standard deviation of 12.8989. The SD gives an idea of how much the individual values in the dataset deviate from the mean.

6.2 Perception on HTI (Overall Results)

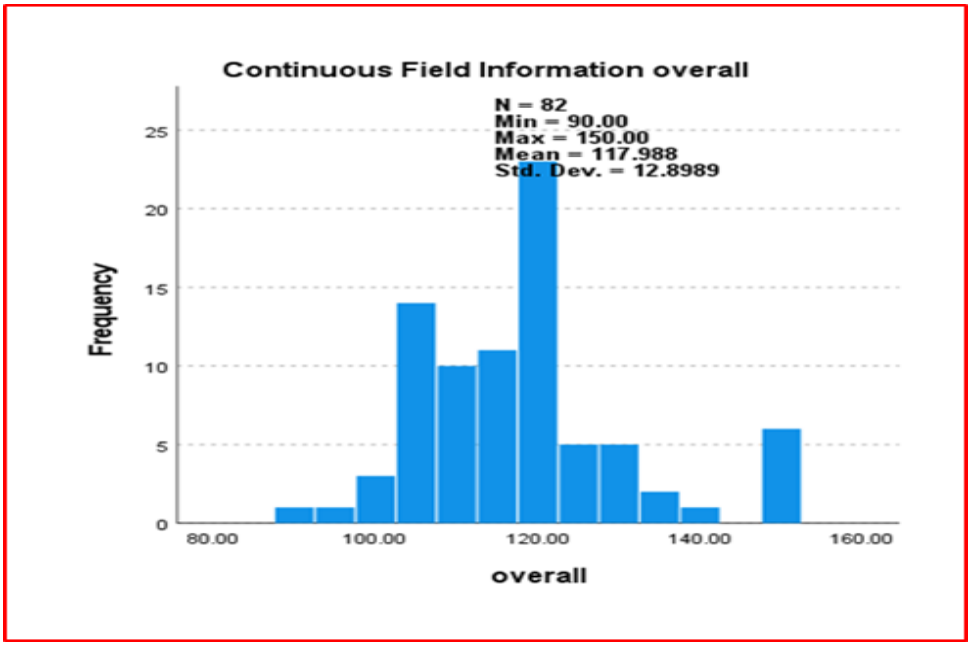

Fig 1: Perception on HTI (overall results)

The above graph represents the minimum and the maximum value obtained from the sample data: Minimum: 90 and maximum 150. The mean is calculated as 117.988. It is to conclude that the standard deviation for N=82 is 12.8989. This predicts that there is a difference in the perception of engineering students on HTI. To ascertain in which the domains their perception differs, we conducted the independent sample Mann-Whitney U-test.

Table 3: Independent Sample Mann Whitney U-Test

Component	Mann-Whitney U	Wilcoxon W	Standardized Test Statistic	Significance (2-tailed)
General Awareness	854.000	1484.000	0.310	0.756
Positive Attitudes	642.500	1272.500	-1.708	0.88
Negative Attitudes	596.500	1226.500	-2.128	0.733
Technology dependence	625.000	1255.000	-1.888	0.059
Philosophical perspective	715.500	1345.500	-1.010	0.313
Perception on HTI	678.000	1308.000	-1.359	0.174

Note: Significance level is 0.05

6.3 Testing of the Hypothesis

The researcher tested the hypothesis to find the perception on HTI by undergraduate Engineering students and the results are given below:

H1: There is a high general awareness on HTI among the undergraduate students which is same across the gender.

From table 3 the general awareness of engineering students is same across the sample. This is clearly inferred from the squared rank value using the Mann Whitney U-test and is determined to be 854.000 and the significant (2-tailed) test result is 0.756. This shows that there is no significant difference found in general awareness. Hence the H1 is accepted and the value is greater than 0.05.

H2: There is no difference in perception on positive attitude on HTI among the undergraduate students which is same across the gender. From table 3 the squared rank value using Mann Whitney U-test is confirmed to be 642.500 and the result of significant (2-tailed) is 0.88. This means that there is no difference in positive attitudes. Hence the H2 is accepted as the significant value is higher than 0.05.

H3: There is no difference in perception on negative attitude towards HTI among the undergraduate students and which is same across the gender. Based on the above table, the significant value is 0.733 which is greater than 0.05. This states that the engineering students do not differ in their perception on HTI and know about the negative impacts of HTI as well.

H4: There is no difference in technology dependence on HTI among the undergraduate students which is same across the gender. From table 3 the squared rank value using Mann Whitney U-test is found to be 625.000 and the result of significant (2-tailed) is 0.059. This indicates that there is no difference in technology dependence. Hence the H4 is accepted as the significant value is larger than 0.05.

H5: There is no difference in perception on philosophical perspective towards HTI among the undergraduate students which is same across the gender. From table 3 the squared rank value using Mann Whitney U-test is determined to be 715.500 and the result of significant (2-tailed) is 0.313. This reveals that there is no much difference in philosophical perspectives. Hence the H5 is approved as the significant value is higher than 0.05.

H6: Perception on HTI (overall) among the undergraduate students is same across the gender. From table 3 the squared rank value using Mann Whitney U-test is found to be 550.000 and the result of significant (2-tailed) is .011. This shows that there is a significant difference in overall performance. Hence the H6 is accepted as the significant value is greater than 0.05.

7. CONCLUSION

The paper titled “A Perception Based Analysis on Human-Technology Interaction by Students of Engineering” tries to address the rapidly emerging area of research called Human-Technology Interaction. To ascertain the perception of engineering students, who are one of the stake holders of technology, a perception analysis survey was conducted. Technology, it is said, has only action and no direction, hence the students of engineering are expected to have a right perception of technology with this view the survey focused areas of general awareness, positive attitudes, negative attitudes,

philosophical perspectives, technology dependence and perception of HTI. The study is significant in the sense it targets the engineering students who are the future uses of technology. This study makes a significant contribution to the field of Human Technology Interaction (HTI), as it presents the perspectives of engineering students on HTI. Developing the right kind of perspectives among the engineering students on HTI is a critical area, for they are going to be the future-developers of technology. The testing of hypothesis reveals that they have a good outlook on technology and have a positive attitude towards it. The study also ensures awareness present among engineering students on various aspects of HTI. As technology is a double-edged weapon, and as we are still striving to find out the ways and means to solve the glitches of technology, developing awareness with a right attitude among engineering students is necessary. Therefore, it is recommended that the concept of HTI may be introduced in the engineering curriculum.

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