

Human-Centred Innovation through Design Thinking for Addressing Cyber Threats, Educational Problems, and Poverty Challenges: An Empirical Study

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Abstract

In an increasingly complex and inter-connected world, organizations and societies face multifaceted challenges such as cyber threats, educational inequalities, and persistent poverty. Traditional problem-solving approaches often fail to address human dimensions of these issues, creating a need for innovative and user-centred solutions. This study examines the role of design thinking as a human-centred innovative approach in addressing cybersecurity challenges, improving educational outcomes, and alleviating poverty. Design thinking emphasises empathy, problem definition, ideation, prototyping, and testing, enabling stakeholders to develop solutions that are both innovative and responsive to needs of the users. The findings reveal that empathy-driven problem identification, collaborative ideation, rapid prototyping and continuous user feedback significantly contribute to the development of effective and sustainable solution. 347 participants were surveyed for the study. The factors studying how Human-Centred Innovation Through Design Thinking for Addressing Cyber Threats, Educational Problems, and Poverty Challenges are Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation and Collaborative Participation.

Keywords: cybersecurity, design thinking, educational innovation, poverty alleviation, sustainable development

Introduction

Human-centred design and design thinking are considered as a strong tool helping entrepreneurs to develop a successful business. By understanding the requirement and desires of customers and later designing products and services that can meet such requirements, business can be built by entrepreneurs that are successful as well as sustainable (Siricharoen, 2023). An innovative method is design thinking that can be used for addressing problems and challenges in different fields to create new innovative solutions aligning with the social requirements, customer value and technological feasibility. Involving in innovative program that uses design thinking is important to address complicated sustainable challenges, which is being faced by the society presently (Villanueva-Paredes et al., 2024). Design thinking is known for its potential to address and deal with complex challenges and has been implemented to resolve the complicated issues of reducing poverty. Approach of Co-design place more emphasis on participatory decision-making as well as stakeholder's collaboration (Pira, Fleet & Moir, 2024). Principles of Design thinking can help in the development of economy-based solutions towards for sustainability issues. For its achievement, sustainability considerations need to be included in the process of problem-solving and approaches of problem-framing should follow same principles (Filho et al. 2024). Design thinking, rooted in human-centered design principles, emphasizing empathy, creativity and iteration in problem-solving. SDG, a global agenda for sustainable development provides a complete framework to address persistent issue like inequality, poverty and degradation of environment (Leong, Leong & Leong, 2024). Lacking communication, mainly with users, diminished the experience level during some phases of design thinking process. Several common challenges are faced by students with most of them are encountered during prototype

phase (Petersen & Killian, 2023). Rising design thinking is related to cultural changes, and today challenges for all is applying their skills to resolve problems. In modern era, quickly changing scenario calls to recast role of design thinking in promoting pro-social changes in society (Jain, 2018). The complexities of Industry 4.0, designers appear as an important figure to guide organization through complicated maze of digital transformation. The expert designers bring human-centered designs, simplification, prototyping and collaboration is the key for the development of personalized solutions that are efficient and effective (Gomide, Patricio & Gancho, 2023). These experts hailing from diverse fields work collaboratively to achieve interdisciplinary synergy that helps in creating such efficient and effective solutions (Mittal et al., 2023).

Literature Review

HCD “Human-Centred Design” has become highly important in modern innovation, mainly in public service and telecommunication. HCD is highly considered as a critical methodology that drives innovation, which is responsive, inclusive and sustainable. It emphasizes an empathetic understanding of needs, behaviour and challenges of users, matching with modern demands in various sectors, mainly in public sector and telecommunication (Adewusi et al. 2022). Using Design Thinking methodology is one possible method in education system to tackle the complicated challenges strategically and creation of strategically and innovative solutions. It indicates that application of design thinking method within this intervention does not have any limitation to prioritise quality of innovative solutions over formal assessment (Herfurth et al. 2025). Human-centred innovations have been focused by companies and the emphasis was highly on cross-functional designs and computational innovations. Design thinking is highly used for shifting the process of thinking from technology-centric to customer-centric (Rao & Kalyani, 2021).

Placement of brainstorming in security practices

Economic, marketing, security and intelligence related issues are fairly been solved on regular basis with the help of brainstorming method. Some brainstorming sessions were conducted in the past to get the solution of a research question raised related to Czech. There are predictive approaches that includes brainstorming meeting involves expert panel to discuss security issues known as “security jams”. Here, brainstorming methods are used to predict the problem and provide the solution to both internal and international security system. Members of expert panel in brainstorming session can be located through “lists of relevant literature, by consulting research institutes, or directly on the basis of recommendations made by established researchers”. The ongoing study can also identify relevant specialists, for example: “by consulting citation indices in representative databases”. Brainstorming methods are also used in “economic decision-making processes” where it helps to improve the effectiveness of caring and development aid.

Design Thinking and Cyber Attack

Design thinking is generally used as means of “researching, ideating, refining, reasoning and prototyping of potential future smart grid security and privacy threats”. Three salient threats are selected to smart grid security in the near future with the help of design thinking framework such as: a) Unauthorized intrusion in control room of a network operator and allow remote shut down of grid infrastructure b) “Distract and Decoy” tactics which diverts the resource away from the attack site c) Manipulate the demand attack by extensive appropriation of household IoT technology (Figure 1)

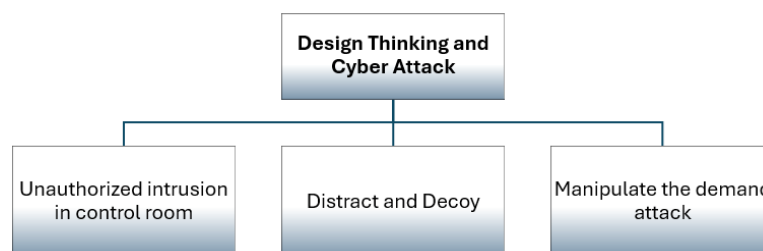


Figure 1 Three Silent Attacks

This method predicts the risk targeted at organization that enable risk owners to secure their attack surfaces ahead of attack execution. Product teams understand needs and challenges of real world with the help of design thinking. They focus on these needs and refine the solutions step-by-step and ensure that the product is “intuitive, accessible, and aligned” with user’s expectations. Since, trust and ease are essential part in cybersecurity, design thinking is applied to improve the process of development and adoption of security solutions. The design-driven approach stimulates the innovation consciousness effectively to impoverish farmers, shows a critical role of sustainable design strategy in optimally aligning resource to the requirements of users. This makes to explore integration of design-driven approach with specific strategies of poverty alleviation, concentrating on its efficacy to improve economic as well as social results for impoverished households. It is highlighted by the findings that the potential of design-driven strategies of poverty alleviation as a valuable tool for practitioners and policymakers (Li, Shi & Wen, 2024, Yadav et al., 2023). The human factor stays significant vulnerability in cybersecurity. Cyber threats becoming more cultured, companies must consider the rising significance to address human behavior in strategies. Cybersecurity approaches that are human-centric are awareness, training, and using behavioral analytics are highly important to mitigate risk related with human errors, neglect and malicious intent (Ayodele et al. 2025). The economic success of companies, more than ever before is dependent on using information and communication technologies. Along with the development, a vital role is played by cyber security ensuring the constant and secure operations of critical application and IT services. The human factors represent important aspect to ensure cyber security in companies that takes a turn for the worse in present time. Activities of security awareness like quizzes, security training and newsletter are conducted to improve the situation, but the impact are slow to materialize and usually do not make lasting impact (Konig & Tjoa, 2022). Design thinking is an analytics and creative process where an individual is motivated to experiment, create and prototype the models (Kaur & Rai, 2024). In cybersecurity, design thinking presents ground-breaking approaches to solving complicated problems. Generally, technical ability over user experience is prioritised by traditional approaches and this leads to solutions that despite being well-structured, lack user acceptance and engagement both. This narrative is flipped by design thinking by placing the users (employees, consumers, or administrators) at the front of the cybersecurity equation. Cybersecurity professionals tune with users to gain valuable insights into their behaviour, pain points, and needs. The bedrock forms through this understanding helps to built innovative solutions. Cybersecurity team provides effective, intuitive and user-centric solutions with the help of design thinking for tasks like “designing user-friendly authentication methods, streamlining security protocols, or simplifying threat detection interfaces”.

Design Thinking and Educational Problems

There are complex, varied, and difficult problems faced by educators in their professional practice. These issues are generally related to teaching and learning topics, social or community, and classroom climate. These “multifaceted, cross disciplinary, human-cantered” are very tough to solve through simple or linear solutions. To deal with these educational problems of practice, it is important for the educators to think creatively. The team suggests design thinking method to provide a user-friendly structure for the teachers that enable them to think creatively and deal with educational problems of practice. While investigating a qualitative study of teaching course which is framed around the uses of design thinking and have creative approach towards educational problems of practice. It is suggested to use design thinking method that has the potential to provide habits of mind that benefit teachers in creative problem navigation. To understand the creative takeaways, experiences of a group of educators working with design thinking processes is examined by the research team. Each of the five modes exposed periodic themes that formed an understanding of their experiences. Figure 2 presents these stages at glance.

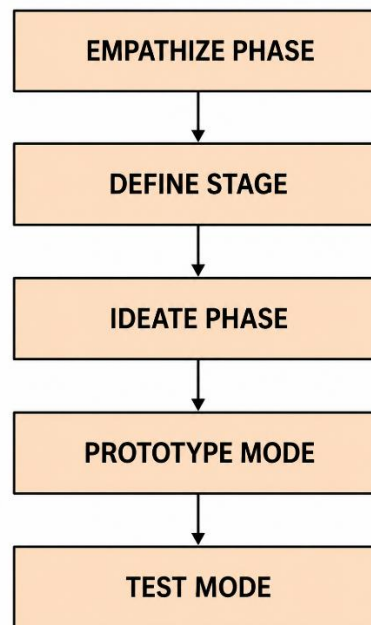


Figure 2 Five Modes of Design Thinking

Empathize phase: the group members found “empathy” as one of new powerful strategy that helps to understand students. Empathy as problem solving strategy (an applicable skill across different educational problems of practice), allow them to “to question, recognize, and challenge” their own assumptions.

Define Stage: It is important to take some time to reconsider and frame the problem properly to know the issue from all the perspectives and get deep understanding of the problem and vision to move forward.

Ideate Phase: In this step, educator gets the opportunity to recognise the “power of idea incubation” as a purposeful way of generating new ideas. Ideation is an opportunity that allows to accept numerous ideas, brainstorm with no wide thinking about solution to problem of practice.

Prototype Mode: This mode shows the excitement of educators to turn the ideas into reality. The students also recognised the relation between “thinking and doing” which helps them to understand that creativity is promoted by prototyping that involves risk taking ability and facing the failure as well.

Test Mode: Educators found that in test mode, the design testing is more productive and learning oriented in comparison to testing which is done in the field of education.

It was noticed that in design testing it is important to have “willingness to fail”, only then one can learn and improve through it. At last, the way the design cycles are reiterative and non-linear is revealed in this phase. All these themes have a good connection with the creativity which is a skill which is rarely received by the teachers. This skill is always required to support and address the problems of practice. The educators can view teaching as a creative design thinking practice when then get an in-service course which can be actively approach teaching with the help of design thinking. Design is seen to solve the problems in the teaching practices and in the field of teaching as well. A student named as Beth, summarised it in the way: the schools always face challenges across the board, to design lessons for the content mastery, to find the finds for professional development, to create learning experience from 21st century, or to differentiate instruction for wide-ranging populations. Usually, these kinds of issues need design thinking to get the solution that has a creative perspective as these problems cannot be solved easily. At the initial stages of the courses, the teachers or the educators do not see themselves as the designers, but at later stages when they are exposed to design thinking and get its experience, they started seeing themselves as the designers.

Use of Design Thinking to deal with poverty

Poverty is considered as one of the most wicked problems that needs deep understanding of all the related challenges which is faced by the people affected by it and addressed effectively. No doubt that the design thinking can deal with these kinds of issues but there are challenges that need the requirement of stakeholder's engagement in the process. The efforts made to reduce the poverty can be hindered if the root cause of poverty is not completely and deeply studied and understood. It is important to gather the insights and perspectives from the key stakeholders with the help of focussed groups, interviews and the surveys to address this challenge. "Low-income families, vulnerable individuals, and marginalized populations, as well as service providers, academics, NFPs, government agencies, charities, donors, and funding agencies" are all includes the stakeholders which are directly affected by poverty. Design thinking is known for its ability to address the intricate challenges. This makes it suitable to be applied to the complicated problem of reducing the poverty. When design thinking is applied in the project of poverty reduction it comes up with new service, product, application, or procedure. The final version is improved when the prototype is shared with the beneficiaries and the mediators. It is necessary to keep in mind that beneficiaries are the end-users of the products while the mediators are the co-developers. This process is human centred which help the multidisciplinary teams in the development of relevant solutions for the complicated or wicked issues where they mainly focus on the requirements and the need of the end-user means the beneficiaries. The key feature of design thinking is that has user-oriented approach and focus on complicated and tough issues. It is usually tough for the end-users to agree on these complicated issues. The wicked problems "represent complex, ill-defined issues characterized by uncertainty, ambiguity, and interdependencies". The conventional problem-solving approaches are challenged by these problems due to their multilayered nature that usually involves conflicts of investor's perspectives and values both. Design thinking is a problem-solving methodology which has its roots in "empathy, creativity, and collaboration", offering a promising approach that helps to deal with wicked problems. Design thinking is different from conventional methods of problem-solving. It had a good grip on ambiguity and complexity that encourages reiterative examination and testing. Design thinking reframes the wicked problems as opportunities for innovation and systemic change and allow the investors to build all-inclusive, contextually relevant solutions addressing the highlighted causes of social challenges. The relation amid wicked problems and design thinking within the theoretical framework is positioned, providing conceptual lens which is use in analysing and interpreting the findings of the research. Design thinking offers a powerful framework to address complicated issues as it makes emphasis on empathy, collaboration and creativity. Its implementation across different sectors shows its versatility and efficacy to drive innovation (Sayankar, 2025). To address the economic challenges of community and deepen the learnings of students, participatory process grounded in social engineering and design thinking is implemented (Phukamchanoad, 2026).

Objective

1. To know the factors influencing "Human-Centred Innovation Through Design Thinking for Addressing Cyber Threats, Educational Problems, and Poverty Challenges"
2. To measure the impact of Human-Centred Innovation on Cyber Threats, Educational Problems, and Poverty Challenges.

Methodology

347 respondents were surveyed from distinct employment sector. Sampling method was "Random sampling" to collect data which was examined by "Explanatory Factor Analysis".

Result Finding

"Table 1" is showing demographics of respondents, it shows that 56.77% are Male participants, 43.23% are female participants. The age of participants is as given - between 25 to 35 years are 30.84%, between 35 to 45 years are 36.60%, and above 45 years are 32.56%. Looking at Sector of Employment, 34.87% are from educational institutes, 30.84% are from government agencies and 34.29% are from NHGOs and other.

“Table. 1 Details of Participants”

“Variables”	“Participants”	%
Gender		
Male Participants	197	56.77%
Female Participants	150	43.23%
Total	347	100%
Age of Participants in years		
25 to 35	107	30.84%
35 to 45	127	36.60%
Above 45	113	32.56%
Total	347	100%
Sector of Employment		
Educational Institute	121	34.87%
Government Agency	107	30.84%
NGO and Others	119	34.29%
Total	347	100%

“Factor Analysis”

“KMO and Bartlett's Test”

Table. 2 Kaiser-Meyer-Olkin Measure of Sampling Adequacy

“Kaiser-Meyer-Olkin Measure of Sampling Adequacy”		.764
“Bartlett's Test of Sphericity”	“Approx. Chi-Square”	6238.682
	df	91
	Sig.	.000

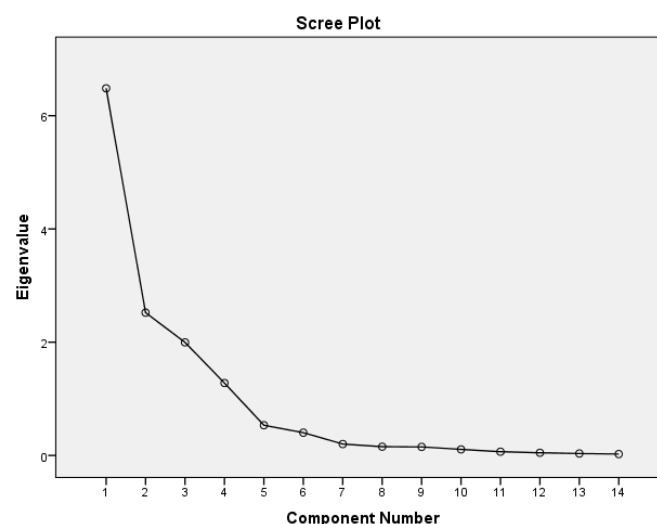
“KMO and Bartlett's Test, value of KMO is .764 (Table 2).”

Table 3 “Total Variance Explained”

“Component”	“Initial Eigenvalues”			“Rotation Sums of Squared Loadings”		
	“Total”	“% Variance”	Of “Cumulative %”	“Total”	“% Variance”	Of “Cumulative %”
1.	6.483	46.310	46.310	3.913	27.948	27.948
2.	2.522	18.017	64.327	3.633	25.951	53.899
3.	1.997	14.261	78.588	2.406	17.187	71.086
4.	1.279	9.139	87.727	2.330	16.641	87.727

5.	.533	3.810	91.537			
6.	.402	2.872	94.409			
7.	.201	1.438	95.847			
8.	.154	1.100	96.947			
9.	.151	1.077	98.024			
10.	.107	.763	98.787			
11.	.065	.465	99.252			
12.	.047	.337	99.589			
13.	.034	.242	99.830			
14.	.024	.170	100.000			

Factors contributing towards explaining total 87.727% of variance. Variance explained by Empathy-driven understanding is 27.948%, Problem identification and Definition is 25.951%, Prototyping and Experimentation is 17.187%, and Collaborative Participation is 16.641%. “(Table 3).”



“Scree Plot”

Table. 4 Rotated Component Matrix

S. No.	Statements	Factor Loading	Factor Reliability
	Empathy-driven understanding		.952
1.	User feedback plays critical role in identifying problems	.953	
2.	Solutions are developed based on use’s needs rather than assumptions	.906	

3.	Understanding stakeholder's perspective improve solution effectiveness	.850	
4.	Empathy helps in designing more inclusive solutions	.843	
	Problem identification and Definition		.962
1.	Problems are carefully analysed before developing solutions	.960	
2.	Root causes of issues are identified systematically	.899	
3.	Problem statements are clearly articulated and well-structured	.893	
4.	Accurate problem definition improves innovation outcome	.870	
	Prototyping and Experimentation		.866
1.	New ideas are tested before full-scale implementation	.912	
2.	Prototypes help identify weaknesses in proposed solutions	.855	
3.	Experimentation improves the quality of innovation	.740	
	Collaborative Participation		.838
1.	Collaboration among stakeholders improve innovation quality	.933	
2.	Community engagement enhances problem-solving effectiveness	.926	
3.	Stakeholder's engagement increases acceptance of solutions	.647	

“Factors of the study and its related variables”

Empathy-driven understanding is first factor, the variables are User feedback plays critical role in identifying problems, Solutions are developed based on use's needs rather than assumptions, understanding stakeholder's perspective improve solution effectiveness and Empathy helps in designing more inclusive solutions. Problem identification and Definition is the second factor, its variables are Problems are carefully analysed before developing solutions, Root causes of issues are identified systematically, Problem statements are clearly articulated and well-structured and Accurate problem definition improves innovation outcome. Prototyping and Experimentation is third factor, variables are new ideas are tested before full-scale implementation, Prototypes help identify weaknesses in proposed solutions, and Experimentation improves the quality of innovation. Last and fourth factor is Collaborative Participation, the variables it includes are Collaboration among stakeholders improve innovation quality, Community engagement enhances problem-solving effectiveness and Stakeholder's engagement increases acceptance of solutions.

Table 5 “Reliability Statistics”

“Cronbach's Alpha”	“Number of Items”
.900	14

Total reliability of 14 items that includes variables for Factors exploring the “Human-Centred Innovation Through Design Thinking for Addressing Cyber Threats, Educational Problems, and Poverty Challenges” 0.900 (Table 5).

Table 6 Model Summary

“Model”	“R”	“R Square”	“Adjusted Square”	R	“Std. Error of the Estimate”
1	.853 ^a	.727	.724		.39788
Predictors: (Constant), Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation, and Collaborative Participation					

“The adjusted R-squared value is 0.727 with approximately 72% of the variation.”

Table 7 ANOVA

“Model”		“Sum Squares”	of “df”	“Mean Square”	“F”	“Sig.”
1	“Regression”	144.210	4	36.052	227.735	.000 ^b
	Residual	54.142	342	.158		
	Total	198.352	346			
a. Dependent Variable: Overall impact of Human-Centered Innovation on Cyber Threats, Educational Problems, and Poverty Challenges						
b. Predictors: (Constant), Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation, and Collaborative Participation						

Value under significant column indicates a significant relationship between Human-Centered Innovation (Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation, and Collaborative Participation) and Cyber Threats, Educational Problems, and Poverty Challenges.

Table 8 Coefficients

“Model”	“Un standardized Coefficients”		“Standardized Coefficients”	“t”	“Sig.”
	“B”	“Std. Error”	“Beta”		
(Constant)	3.957	.021		185.248	.000
Empathy-driven understanding	.332	.021	.438	15.503	.000
Problem identification and Definition	.062	.021	.081	2.877	.004
Prototyping and Experimentation	.251	.021	.331	11.719	.000
Collaborative Participation	.490	.021	.647	22.913	.000
DV: Overall impact of Human-Centered Innovation on Cyber Threats, Educational Problems, and Poverty Challenges					

All the factors Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation, and Collaborative Participation are showing significant impact of Human-Centered Innovation on Cyber Threats, Educational Problems, and Poverty Challenges. Highest impact is shown by Collaborative Participation with beta value .647 followed by Empathy-driven understanding (.438), Prototyping and Experimentation (.331), and Problem identification and Definition (.081).

Conclusion

The study examined the role of human-centred innovation through design thinking in addressing complex societal challenges, including cyber-threats, educational problems, and poverty related issues. The findings indicate that design thinking provides a structured yet flexible approach that enables organizations and communities to better understand user needs, identify root cause of problems, generate innovative solutions, and continuously refine interventions through feedback and experimentation. The result suggests that key dimensions of design thinking like empathy, problem definition, ideation prototyping, and collaboration significantly contribute to the development of effective and sustainable solutions. The study highlights the contribution of stakeholders and cross-sector collaboration in ensuring that innovation remains relevant, scalable and sustainable. Organizations that embrace human-centred design are better positioned to respond to rapidly changing technological, educational, and socioeconomic environment. The factors studying how Human-Centred Innovation Through Design Thinking for Addressing Cyber Threats, Educational Problems, and Poverty Challenges are Empathy-driven understanding, Problem identification and Definition, Prototyping and Experimentation and Collaborative Participation. The study concludes that there is significant of impact of Human-Centered Innovation on Cyber Threats, Educational Problems, and Poverty Challenges.

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