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HUMAN-COMPUTER INTERACTION

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December 5-6, 2025
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Keynote Speakers

Prof. Dr. Evrim Baran

Helen LeBaron Hilton Chair in the School of Education, Iowa State University - U.S.

Talk Title:
Human Centered AI in Education: From Values to Practice

Abstract:

As artificial intelligence (AI) advances, it is becoming central to teaching, learning, and school operations. While its potential to support educators is significant, that promise is tempered by risks related to bias, fairness, transparency, and accountability. In response, researchers and practitioners are turning to human-centred artificial intelligence (HCAI)—an approach that aims to align AI with human values and needs. Within the AI in Education space, HCAI necessitates new design considerations to ensure that AI solutions augment, rather than replace, educators by keeping them informed, preserving their agency, and aligning with learning goals and ethical safeguards. HCAI emphasises human-in-the-loop practices in which educators and designers maintain oversight and actively shape how AI tools are designed, integrated into teaching and learning, and evaluated. Drawing on our research in human-centred design, this keynote articulates HCAI principles and methods for educational contexts, including interfaces, tools, workflows, and systems designed for educators and designers. By considering these principles, characteristics, and qualities when designing educational solutions, we will explore how the intersection of AI and HCI methods can be applied to ensure HCAI in practice.

Bio:

Evrim Baran is a Professor and the Helen LeBaron Hilton Chair in the School of Education at Iowa State University and a faculty member in the Educational Technologies and Human–Computer Interaction programs. Her research sits at the intersection of HCI, the learning sciences, and teacher education, using human-centered design to create and evaluate educational technologies across diverse contexts. Dr. Baran's work has been supported by leading funders—including the National Science Foundation and the European Commission—and has informed teacher education and digital learning initiatives in the U.S. and internationally. Recent projects focus on human-centered AI in education, developing curricula and evaluation frameworks that build AI literacy and strengthen educator agency. Her interdisciplinary team collaborates with colleagues in design and engineering, and partners with K–12 schools to implement educational technology solutions in classrooms. She teaches courses in learning design and human–computer interaction.

Prof. Dr. Radu-Daniel Vatavu

Machine Intelligence and Information Visualization Lab (MintViz), "Ștefan cel Mare" University of Suceava - Romania

Talk Title:

Expanding Human Sensing and Cognition in New, Extended Reality Worlds

Abstract:

Extended Reality technology is rapidly advancing, gradually transforming the way we perceive, understand, and interact with the world around us. By grounding perceptual and cognitive extensions in our everyday physical experiences, new opportunities arise for interactions that involve mixed, physical-virtual objects and phenomena. All these opportunities invite us to reconsider the influence of interaction design on our sensory and cognitive capabilities. In this talk, I will present how the integration of casual interactions into extended reality environments can naturally support sensory and cognitive augmentation with insights from interactive technology design, learning theory, and philosophy and implications for future mobile, wearable, and ambient technologies.

Bio:

Radu-Daniel Vatavu is a Professor of Computer Science at the Stefan cel Mare University of Suceava, where he conducts research in Human-Computer Interaction, Augmented/Mixed/Extended Reality, Ambient Intelligence, and Accessible Computing. His work primarily focuses on natural interaction with computing systems, ranging from mobile and wearable devices to large displays and extended reality environments. He directs the Machine Intelligence and Information Visualisation Lab, an interdisciplinary research laboratory dedicated to advancing knowledge in natural, meaningful, and accessible interactions among humans, computers, and environments. His research has received multiple awards, including at CHI, EICS, ICMI, IMX, and W4A, and he is an elected Corresponding Member of the Romanian Academy.

Associate Professor Zerrin Yumak

Department of Information and Computing Sciences, Utrecht University - Netherlands

Talk Title:

Learning to Gesture: Deep Models for Non-Verbal Behaviour in Digital Humans

Abstract:

With recent advancements in computer graphics, 3D digital humans have achieved an impressive level of visual realism. They are increasingly being integrated into diverse applications, including video games, customer service and finance chatbots, educational and healthcare simulations, remote communication, and social extended reality (XR). However, their ability to interact and move naturally within social contexts remains limited. As humans, we are highly attuned to non-verbal behaviors in emotional and social interactions. For digital humans to engage with us more naturally, they must be equipped with non-verbal communication skills such as facial expressions, gestures, and gaze. As they are deployed in more interactive environments, the demand to generate their behavior automatically and in real time is growing. Yet, capturing and synthesising the nuanced, individual nature of nonverbal behaviours remains a significant challenge, hindered by limitations in data availability, the complexity of algorithms, and evaluation methodologies. In this talk, I will explore how AI and deep learning techniques—particularly those leveraging motion capture technology—can be used to model and generate the non-verbal behaviors of digital humans. I will present the state-of-the-art, highlight our recent research, and offer a critical examination of current evaluation practices in non-verbal behavior synthesis.

Bio:

I am an associate professor at the Human-Centered Computing Group, Department of Information and Computing Sciences at Utrecht University in the Netherlands and director of the Motion Capture and Virtual Reality Lab. I obtained my PhD degree in Computer Science from University of Geneva. I was a scientific collaborator at EPFL, Switzerland. Following that, I have been at the Institute for Media Innovation, Nanyang Technological University, Singapore as a research fellow. My research is on believable virtual humans and social robots. I work on computational models of social and emotional behaviours and expressive character animation, combining methods from computer graphics, artificial intelligence and human-computer interaction. My research is interdisciplinary with applications in games, virtual reality and robotics: Expressive character animation (e.g. face, gaze, gestures) Social interaction and groups of virtual characters, Machine learning and deep learning models for character animation, Autonomous behaviour for virtual humans and social robots, modelling emotion and memory for virtual humans and social robots.

Nicola Bersanetti

Senior Business Development Manager for the EMEA region at EON Reality - Italy

Talk Title:

From XR Classrooms to AI-Enhanced Careers: Transforming Higher Education for the 21st Century

Abstract:

Higher education currently navigates significant challenges, specifically the reliability of traditional assessments in the generative AI era and the need to bridge the gap between academic curricula and workforce demands. EON Reality presents "The Third Way," a pedagogical framework designed to empower academic institutions by integrating Extended Reality (XR) and Spatial Artificial Intelligence (AI) to enhance the educational value proposition. Far from displacing traditional structures, this model supports faculty by shifting the focus from passive information consumption to immersive, competency-based learning.

The ecosystem strengthens institutions through three pillars: Skills, Jobs, and Income. To support educators, the framework introduces Brainy Mentors—highly photorealistic AI Avatars capable of conducting lectures and delivering personalized tutoring. These intelligent agents utilize adaptive learning and engagement strategies to tailor educational pathways to individual student needs, extending the reach of faculty. To preserve academic integrity and alleviate administrative burdens, the model replaces vulnerable written assignments with simulated oral exams and practical XR assessments, ensuring verifiable skill mastery that AI cannot falsify.

Furthermore, the platform assists institutions by using AI to dynamically align curricula with real-time labor market data, ensuring graduates possess relevant, high-demand skills. Finally, it equips students with entrepreneurship tools, reinforcing the university's status as a driver of economic mobility. Guided by the "Team Human" philosophy of accessible, cost-effective education with democratize access, this approach revitalizes the university's role, from a degree provider into an indispensable, lifelong partner in career success and economic resilience.

Bio:

Nicola Bersanetti is Senior Business Development Manager for the EMEA region at EON Reality, a global leader in Extended Reality (XR) and Artificial Intelligence technologies for education and training, in both academic and corporate settings. Founded in 1999 and headquartered in Irvine, California, EON Reality specializes in democratizing knowledge through innovative no-code solutions that enable organizations worldwide to create interactive, immersive learning experiences across devices for education, industry, and workforce development.

With over 15 years of experience in managing complex projects, Nicola leads strategic partnerships and international expansion programs, helping organizations leverage cutting-edge XR and AI technologies to make complex skills more accessible and engaging.

Before joining EON Reality in 2020, Nicola collaborated for many years with private investors, investment funds, and institutional investors, alongside public entities and institutions, gaining significant experience in managing strategic projects and business development programs in Italy and abroad.

His studies in law, combined with the experience gained over the years, allow him to merge technical expertise with negotiation skills and an extensive network of international contacts in the business development field.

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A New Approach to Information Hierarchy Based on Data Spaces and Intelligent Digital Twins: Cyclic Layers Model (CLM)

Melike Kukut[1[0000-0003-4730-0441]], Sevinç Gülseçen[2[0000-0001-8537-7111]], Zümrüt Ecevit Satı[3[0000-0002-7246-6518]], Hulusi Gülseçen[4[0000-0002-8798-5468]]
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Abstract

The rapid evolution of the digital era exposes the limitations of traditional hierarchical information models, such as Ackoff's DIKUW and Bellinger's DIKW pyramid, which fail to fully address contemporary challenges in data management and ethical technology use. This study introduces the Cyclic Layers Model (CLM) as a unified, holistic alternative that consolidates fragmented knowledge management approaches into a single, dynamic framework. Drawing from bibliometric analysis of 1074 publications (1985–2025) across major databases, and narrowing to 535 relevant studies, the model restructures information flow through cyclic, interconnected layers that incorporate individual, organizational, and environmental factors. By integrating Data Spaces and Intelligent Digital Twins (IDTs), the model offers a comprehensive approach to addressing ethical AI deployment, data privacy, and sustainability issues. This framework not only advances theoretical understanding in knowledge management but also provides practical pathways for responsible decision-making in sectors such as healthcare and smart cities. CLM thus sets the stage for future multidisciplinary research aimed at designing ethically and culturally aware intelligent systems.

Keywords: DIKW pyramid, DIKUW, Data Spaces, Intelligent Digital Twins, Cyclic Layers Model.

A Machine Learning Approach to Real-Time Human-Computer Behavioural Baseline Deviation Detection via Multimodal Interaction Analysis

Kamran N. Asgarov[0009-0000-3659-024X]
Azerbaijan Technical University, Baku, Azerbaijan
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Abstract

Each person has their own unique interaction habits and skills when using a computer. These habits are formed in the subconscious and muscle memory, and can be called a person's digital signature, analogous to a fingerprint in the physical world. This paper presents a framework for constructing user's behavioural baseline that reflects their unique interaction habits. The baseline is formed by extracting most useful features from computer interaction telemetry metrics such as mouse dynamics, keystrokes dynamics and application usage. Then collected data is used to train an unsupervised machine learning model that uses multimodal principle to detect anomalies using fusion method. The machine learning methods used were Local Outlier Factor, One-Class Support Vector Machine), Isolation Forest, and the Elliptic Envelope. The proposed model was tested using data collected from 12 users in three age categories as part of this study. Users performed one of three tasks, and data was recorded while they performed these tasks. The results showed that the proposed model accurately recognizes differences between users performing different tasks. However, it produced an F_1 score of 0.72 in recognizing differences between users of the same age group who performed the same task. Overall, results indicate that multimodal system with fusion method can robustly detect behavioural deviations in real time, and motivate future work on richer context features.

Keywords: anomaly detection, behavioural biometrics, interaction analysis.

Multi-Criteria Evaluation of AI-Based Translation Applications: An AHP and TOPSIS Approach

Ersin Şahin[1] [0000-0003-4466-7483], Cansu Şahin Kölemen[2] [0000-0003-2376-7899]
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Abstract

Artificial intelligence has significantly influenced the development of translation technologies, enhancing both the speed and accessibility of multilingual communication. Despite the growing availability of platforms such as DeepL, Google Translate, ChatGPT, Yandex Translate, and Google Gemini, determining the most effective tool remains complex due to varying levels of accuracy, fluency, usability, and data protection. To address this issue, this study adopts a structured multi-criteria decision-making (MCDM) framework to assess AI-based translation systems. Through expert consultation, seven evaluation criteria were identified: translation accuracy and meaning preservation (K1), terminology consistency (K2), language fluency and style (K3), speed (K4), data privacy (K5), cost (K6), and usability (K7). The Analytic Hierarchy Process (AHP) was applied to assign weights to each criterion. Findings indicate that terminology consistency (29.26%), language fluency and style (28.07%), and translation accuracy (27.13%) are the most influential factors, jointly accounting for nearly 85% of the overall weight. In contrast, speed (3.11%), data privacy (2.72%), and usability (3.37%) were considered less critical. Subsequently, the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) was employed to rank the platforms. ChatGPT ranked highest with a closeness coefficient of 1.0, followed by DeepL (0.9458), Google Gemini (0.6058), Google Translate (0.0825), and Yandex Translate (0.0). These results emphasize the strong performance of large language model-based systems in terms of contextual understanding and fluency, while also highlighting the limitations of other tools in areas such as terminology management and semantic accuracy.

Keywords: AI-based translation, Multi-criteria decision-making, Translation evaluation, AHP, TOPSIS

Mapping of Studies Conducted with Eye Trackıng Devices: A Topic Analysis

Muhammed Güler[1][0000-0001-5353-2690], Embiya Çelik[2][0000-0002-6703-8578], Derya Çakmak Karapinar [3][0000-0003-0796-1800]

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Extended Abstract

The monitoring, analysis, and recording of eye movements is considered to be an effective method for understanding the processes that occur in the mind (Çağıltay, 2011). The process of determining and measuring the point where the eyes are looking is called eye tracking. These measurements are usually made by recording eye movements on video (Wikipedia, 2025). Tools that record eye movements are called eye tracking devices. Eye tracking devices help to collect various data, such as where the eyes are looking, the first place they look at, the number of times they focus, heat maps, the number of jumps, the jump duration, the number of pauses, the eye's scanning path, and the total time (Baştuğ et al., 2019). Eye-tracking studies have become widespread since the development of computer technologies in the 1980s. While it was once only used to observe eye movements, it is now used for a much broader range of applications, from marketing to web design, and from neurology to social psychology, to understand human behavior and cognitive processes. From its initial role as a basic observation tool, it has evolved into an integrated technology capable of performing more complex social and scientific analyses. These studies, which cover a wide range of topics, are important for revealing the thematic structure of historical processes thanks to topic modeling methods such as the Structural Topic Model (STM). STM is a machine learning method used to identify different themes (distinct themes) or hidden structure in a text library. It extends traditional topic modeling approaches by allowing the inclusion of document-level metadata (such as time, author, or source) to explain variations in topic prevalence and content. This makes STM particularly useful for examining how topics change across contexts or groups and for testing hypotheses about relationships between text structure and external variables (Roberts, Stewart, & Tingley, 2019).

This study also analyzes the thematic structure of studies in the field of "eye-tracking" using the Structured Topic Model. To this end, the SCOPUS database, which provides a comprehensive index of scientific

publications, was used to conduct a thorough analysis of the research. To identify relevant studies;

- Containing the keyword “eye-tracking,”
- Published between 2000 and 2024,
- Publication language is English
- Full-text articles have been selected.

As a result of the specified criteria, a pool of 30,275 articles was created.

As a result of the STM analyses performed, 15 topics were identified from the studies. These topics are as follows.

- T1: Eye Movement and Visual Perception (movement, eye movement, saccades, visual, pursuit, motion)
- T2: Human-Computer Interaction and Usability (user, interaction, computer, interfaces, usability, design)
- T3: Social Attention and Child Development (social, child, children, face, attention, autism, gaze)
- T4: Virtual Reality and Driving Simulation (virtual, driving, virtual reality, driver, safety, environment)
- T5: Eye Tracking and Gaze Estimation (gaze, head, eye gaze, display, tracking, calibration)
- T6: Reading, Language, and Speech Processing (reading, language, speech, comprehension, processing, lexical)
- T7: Visual Acuity and Optical Studies (visual, acuity, optical, retina, study, coherence)
- T8: Machine Learning and Pattern Recognition (learning, model, models, neural, machine, classification)
- T9: Brain Imaging and Cognitive Neuroscience (brain, cortex, magnetic, imaging, resonance, neural)
- T10: Visual Attention and Perception Processes (visual, attention, perception, search, decisions, information)
- T11: Image Processing and Computer Vision (image, detection, computer, processing, algorithm, surgery)
- T12: Cognitive Processes and Data Analysis (data, cognitive, analysis, research, processing, students)

- T13: Gender and Human Development Studies (adult, female, male, young, adolescent, human)
- T14: Clinical and Cognitive Testing (clinical, study, cognitive, test, pupil, mental)
- T15: Visual Attention and Eye Fixations (attention, visual, fixation, participants, behavior, task)

The studies conducted have been grouped around the 15 topics mentioned above. These topics span a wide range of fields, from eye tracking to virtual reality, image processing, and cognitive testing. The most fundamental concepts on which the studies determining these topics have focused are indicated alongside the topic with keywords. The five most popular topics among these are ranked as T12, T15, T2, T5, and T10.

When examining how countries approach popular topics, most research has been conducted in the USA (5829). This is followed by Germany (2384) and China (2327). Both the USA and Germany have conducted the most research on Topic 12: Cognitive Processes and Data Analysis.

The analysis identified topics whose popularity is increasing and decreasing. Accordingly, topics T15, T3, T8, T12, and T4 remain current and popular, while topics T1, T10, T9, T11, and T7 have gradually weakened, and the number of studies conducted has decreased.

According to the results of the STM analysis, eye tracking research has diversified significantly in the last two decades, covering a wide range of areas from cognitive neuroscience to human-computer interaction. This diversity reflects the field's evolution from simple eye tracking to an interdisciplinary research paradigm that integrates artificial intelligence, data analytics, and behavioral sciences. Consistent with previous bibliometric findings (Holmqvist et al., 2017; Duchowski, 2018), topics related to cognitive processes (T12) and visual attention (T15) have been seen to increase in popularity, thus providing a better understanding of how visual information is processed and how it influences learning and decision-making.

Keywords: Eye-tracking, Structure topic modelling, STM, Trend analysis

Comprehensive Comparison of Semantic Image Similarity Analysis Techniques with Traditional Methods Using the NITS-IQA Dataset

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Abstract

Automating evaluation processes in interactive systems is essential for reducing human effort and ensuring reproducible software testing. This study investigates semantic/feature-based metrics (DINOv2, DISTS, OpenCLIP) versus the traditional structural metric (SSIM) on the NITS-IQA dataset, aiming to identify suitable methods for automated testing of video-conferencing applications. A modular evaluation pipeline with an interactive GUI was developed to support scalable experiments under diverse distortion conditions. Results indicate that semantic metrics provide higher agreement with subjective judgments (PLCC: 0.716, SROCC: 0.730) and lower error rates (RMSE: 15.67%), demonstrating their reliability for capturing perceptual content preservation. By integrating these findings into automated workflows, the study offers actionable insights for sustainable test automation and contributes to advancing objective evaluation techniques in Human-Computer Interaction.

Keywords: Test automation, semantic similarity metrics, NITS-IQA, perceptual quality assessment, Human-Computer Interaction, reproducible evaluation workflows

Subject-Dependent EEG-based Emotion Recognition: Preliminary Results from the EPOK Dataset

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Abstract

Emotion recognition constitutes an important research area for understanding individuals' mental states and enhancing human–computer interaction. In recent years, EEG-based brain–computer interfaces enable emotions to be detected more objectively and reliably. In this study, EEG-based emotion recognition is performed using traditional machine learning methods, specifically Support Vector Machine (SVM) and Logistic Regression (LR). As part of this preliminary evaluation conducted on the EPOK EEG dataset, which is developed using visual stimuli, emotional states are classified separately along the dimensions of arousal (low/high) and valence (low/high). In the preprocessing stage, raw EEG signals are divided into sub-frequency bands, and their Differential Entropy (DE) is calculated. Finally, the signals are classified using SVM and LR classifiers. The performance of the models is evaluated based on accuracy, precision, recall, and F1-score. For SVM, the classification accuracies for valence and arousal are 73.14±5.20% and 78.35±6.81% respectively. In contrast, for LR, the accuracies are calculated as 71.79±5.15% and 77.20±7.62% for valence and arousal, respectively. This study introduces the newly developed EPOK EEG dataset to the literature and demonstrates that effective emotion recognition can be achieved with visual stimuli and a low-cost EEG device.

Keywords: EEG, Emotion Recognition, Affective Computing, Machine Learning, EPOK.

Evaluating the Usability of Traditional Text-Based CAPTCHAs Versus Modern CAPTCHA Designs in Online Interfaces

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Abstract

CAPTCHAs is are accepted authentication method meant to verify whether users are human or automated bots, with debate about their usability and effect on user experience. This research compared three types of CAPTCHAs: reCAPTCHA, KeyCAPTCHA, and a Traditional Text-Based CAPTCHA, considering efficiency, accuracy, and subjective usability in online interactions. Twenty-four participants completed several pre-determined tasks using each CAPTCHA type on a controlled test platform. Performance measures included completion time and error frequency. A questionnaire was administered after each task to measure mental demand, clarity, ease of use, time efficiency, frequency of errors, and overall satisfaction. The results indicate that participants completed the tasks more quickly and with fewer errors when using the traditional text-based CAPTCHA compared to reCAPTCHA or Key CAPTCHA. Subjective evaluations further revealed that the text-based CAPTCHA was perceived as clearer, easier to use, and less mentally demanding. In contrast, while KeyCAPTCHA was more tolerant of input errors, participants considered it slower and less intuitive. reCAPTCHA yielded the highest overall error rate. Collectively, these findings suggest that participants expressed the greatest satisfaction with the traditional text-based CAPTCHA design. This study shows that, despite the debate over their robustness against automated solutions, traditional text-based CAPTCHAs can offer the best balance of usability and user experience. It underscores the need for future CAPTCHA designs to integrate the efficiency and satisfaction of simpler formats with the enhanced security features of modern alternatives. The study offers actionable insights for practitioners and researchers developing user-centric authentication systems.

Keywords: HCI, CAPTCHA, reCAPTCHA, KeyCAPTCHA, Text-based CAPTCHA, Usability Evaluation, User Experience.

A Bibliometric Analysis on the use of Eye-Tracking Technology in Media Research

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Abstract

Eye-tracking data provides valuable information about many aspects of human cognition, perception, and behavior, allowing researchers to understand individuals' gaze patterns, information processing methods, and decision-making processes. Eye-tracking technology captures the eye's gaze using the eye-tracker's cameras. This understanding has led to many advances in various fields (Duchowski 2017). Eye-tracking technologies have been used extensively in various disciplines in recent years, particularly in cognitive psychology and neuroscience. They are also being applied to marketing and consumer behavior, reading strategies in educational sciences, and news consumption and digital interface use in communication and media studies (Holmqvist et al., 2011; Lai et al., 2013; Wedel & Pieters, 2021). One of these is the widespread use of eye-tracking in the media field. This study aims to examine the eye-tracking method used in media research using a bibliometric analysis approach. A search was conducted in the Web of Science database using the keywords "media" and "eye-tracking." The search yielded a total of 3,667 studies. The identified studies were evaluated in accordance with the PRISMA guidelines (Moher et al., 2015) to meet consistency and transparency standards in systematic review processes. 1,242 studies were included in the study. These articles were analyzed using VOSviewer data visualization software for publication year, language of publication, country, keywords used, most cited authors, and inter-author connectivity. According to the research findings, the most publications in this clearly interdisciplinary field were in Experimental Psychology with 128 studies. This was followed by Neuroscience with 117 publications and Communication with 110. When the distribution by year was examined, it was determined that the first study was conducted in Computer Science in 1991. The linguistic distribution of the publications revealed that 96.2% of the studies were in English, while Turkish, Dutch, and German were among the least commonly used languages, with only one publication each (0.08%). In terms of country-specific distribution, the United States leads with 370 publications, followed by Australia (41) and Austria (32). The countries with the fewest publications are Sweden (32) and Taiwan (17). In the keyword analysis, "eye tracking," "visual attention," and "autism" stand out as the most frequently used terms. These results suggest a conceptual and methodological roadmap for future studies on the use of eye tracking in media research.

Keywords: Media, Communication, Eye Tracking, Media Research, Bibliometric Analysis.

Measuring Methodological Preference: A Preliminary Scale for the Qualitative-Quantitative Divide in Human System Research

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Abstract

This paper investigates methodological orientations in Human-System Interaction research, focusing on the enduring tension between qualitative and quantitative assessment paradigms. Historically, the field has incorporated both subjective, descriptive accounts and data-driven approaches. A contemporary shift, often driven by technological advancements, has further promoted the adoption of quantifiable metrics. This study is conceptually inspired by the Coalition for Advancing Research Assessment (CoARA) workshop, which calls for a systemic reform of assessment practices to be more inclusive and effective, prioritising qualitative judgment supported by quantitative indicators. Translating this principle from research assessment to human-system interaction evaluation practice, we posit that a researcher's inherent methodological preference represents a critical yet under-examined factor in study design, one that fundamentally shapes both participant experience and research outcomes. Therefore, this study investigates whether individuals can articulate a consistent inclination toward qualitative or quantitative methods. A forced-choice questionnaire was administered within Human-System Interaction (HSI), a discipline that naturally accommodates both research traditions. The primary aim was to develop a preliminary scale to gauge an individual's inherent methodological inclination. Unlike traditional Likert-type or posttest usability scales, this instrument measures general preference independently of specific evaluation contexts. This initial proof-of-concept confirms that individuals can express consistent methodological preferences. The present analysis is confined to descriptive and nonparametric statistics; subsequent research will randomize item pairs, refine the statement pool, and incorporate a sureness dimension to enhance the scale's discriminant validity.

Keywords: Qualitative vs Quantitative, Human-System Research, Usability Measurement, U/X Evaluation, Scale Development, CoARA, CI-KPI.

"This photo is fake!": How primary selective attention to photograph content affects its perceived authenticity

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Abstract

In today's online media journalistic sphere, photographs more than ever before help convince users of the veracity of news. This can push forward "fake news", and eclipse real information However, it is unknown whether directing attention to particular elements of image content can affect individual authenticity perception of photographs used in journalism Therefore, it is crucial to understand which type of content affect the subjective perception of a photograph as true or fake, and if those categories are tied to individual factors, as photo graphs often give credence to the associated text. To this end, we ran an eye-tracking study, where 50 participants were free-viewing journalistic photographs, without any instruction bias. As a result, we see that prolonged primary attention to some categories influences the subjective authenticity in different directions depending on the content. The results and their implications for the future are discussed.

Keywords: visual attention, authenticity perception, media, photographic content, political orientation

Deep Learning Approaches for EEG-Based Emotion Recognition: A Systematic Review on DEAP and DREAMER

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Abstract

Emotions are a fundamental part of human life and an important factor influencing individuals' thoughts, behaviors, and decisions. In the context of human-computer interaction, emotion recognition is becoming increasingly important, particularly for enriching the user experience and enabling more natural interactions. As a key component of affective computing, this capability allows systems to sense and adapt to users' emotional states. Recently, there has been an increase in emotion recognition studies conducted using EEG signals. However, the multidimensional and noise-sensitive nature of EEG signals makes manual feature extraction difficult, making deep learning (DL) based approaches advantageous. This study systematically analyzes DL approaches applied to the widely used EEG-based emotion recognition datasets DEAP and DREAMER. A total of 185 scientific publications were evaluated in terms of fundamental stages such as signal preprocessing, feature extraction, and DL architectures. The findings reveal that the CNN architecture (N=129) is the most frequently used approach, followed by the LSTM (N=45) and GRU (N=16). Artefact removal, filtering, and normalization techniques are frequently applied in preprocessing steps, while frequency-based methods (N=132) are predominantly preferred for feature extraction. In the reviewed studies, various approaches have been employed depending on whether raw or preprocessed EEG signals were used and on model requirements. The study contributes to the literature by synthesizing current DL practices in EEG-based emotion recognition and by identifying common methodological patterns that may inform future research in the field.

Keywords: Affective computing, Deep Learning (DL), Electroencephalography (EEG), Emotion recognition, DEAP, DREAMER.

Inclusive Human–Computer Interaction for Speech Therapy: AI-Driven Design and Experimental Study with Neurodiverse Learners

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Extended Abstract

Communication is one of the most essential human skills that enables participation, learning, and social interaction. However, many neurodiverse learners, including children with autism spectrum disorder (ASD), articulation difficulties, or expressive language impairments, face significant challenges in developing these skills effectively. Traditional speech therapy and communication tools are often limited in personalization, adaptability, and accessibility, offering one-size-fits-all exercises that do not fully address individual differences in cognitive processing or emotional state. With the rapid advancement of artificial intelligence (AI) and human-computer interaction (HCI) technologies, there is a growing opportunity to create intelligent systems that adapt dynamically to each learner's communicative needs. In particular, AI-driven assistive technologies can recognise speech errors, analyse emotional cues, and provide real-time feedback tailored to the user's profile. Despite this potential, there is still a lack of human-centred studies that explore how neurodiverse individuals interact with such systems — especially in terms of usability, emotional engagement, and learning comfort. This study aims to design and evaluate an AI-powered communication aid that supports speech and language development through multimodal interaction (voice, visual, and tactile feedback). The system is specifically created for neurodiverse learners, emphasising empathy-driven interface design, accessibility, and emotional adaptivity. By combining machine learning models with inclusive HCI principles, the research seeks to bridge the gap between assistive technology and real-world learning environments. The proposed system was developed following a Human-Centred Design (HCD) framework, ensuring that every design decision was guided by the actual needs and experiences of neurodiverse learners. The development process consisted of three iterative phases: (1) needs assessment and requirement analysis, (2) prototype development, and (3) user testing and refinement. 2 In the initial stage, semi-structured interviews were conducted with three speech and language therapists and five special education teachers to understand common barriers in digital communication aids. The insights guided the design of a

prototype that prioritises simplicity, clarity, and adaptive feedback mechanisms. The core architecture integrates three main AI modules: 1. Speech Recognition Engine (Whisper-based) – Converts spoken input into text, detecting phonetic errors and pauses. 2. Natural Language Processing (NLP) Module – Analyzes sentence structure, semantic accuracy, and expressive language patterns. 3. Emotion Recognition System (FER+) – Processes facial and vocal cues to determine the learner's emotional state, dynamically adjusting the feedback tone (e.g., encouraging voice when frustration is detected). The multimodal interface combines visual cues (animated mouth movements and colour-coded feedback), auditory guidance (AI-generated verbal prompts), and tactile vibration signals for learners with attention or auditory processing difficulties. The pilot study involved twelve participants aged between 8 and 13 years: six learners with mild speech or language difficulties, four with ASD traits, and two without diagnosed disorders (control group). Each participant interacted with the system across five 30-minute sessions over two weeks. For evaluation, two standardised tools were employed: the System Usability Scale (SUS) to assess interface usability and the NASA Task Load Index (NASA-TLX) to measure perceived cognitive workload. In addition, qualitative feedback was gathered from therapists through observation forms and post-session interviews. The evaluation revealed that the AI-driven communication aid achieved high usability and strong user acceptance among both learners and therapists. According to the System Usability Scale (SUS), the system scored an average of 86.7 out of 100, indicating an "excellent" level of usability. Participants required minimal guidance to navigate the interface, and most could complete speech imitation and recognition tasks independently after the second session. The NASA-TLX results showed a 25% reduction in perceived cognitive load compared to traditional tablet-based speech training tools used in control sessions. Learners reported that the visual colour-coding and emotive feedback system helped them stay focused and understand their progress without external prompts. Therapists also emphasised that the adaptive responses—such as calming voice tones when frustration was detected—significantly improved learner engagement and emotional regulation during practice. Qualitative observations from video recordings and post-session interviews identified three recurring themes: 1. Engagement through Empathy – Learners expressed positive emotions toward the AI's voice tone and visual encouragement, perceiving the system as "friendly" and "understanding." 2. Confidence in Expression – Several participants began producing longer and clearer verbal outputs over repeated sessions, suggesting improved expressive motivation. 3 3. Personalised

Learning Flow – The multimodal feedback design allowed learners to progress at individualised speeds, reducing anxiety and dependence on external correction. Together, these findings suggest that integrating affective computing and inclusive interface design principles can create emotionally resonant and cognitively accessible learning experiences for neurodiverse populations. The findings of this study highlight the transformative potential of AI-driven assistive communication tools when guided by human-centred design principles. Unlike conventional speech therapy software, which often relies on repetitive and static tasks, the proposed system adapts dynamically to each learner's performance and emotional state. This adaptivity allowed neurodiverse users to engage with the system as an interactive partner rather than a corrective evaluator, promoting intrinsic motivation and emotional resilience during speech practice. From an HCI perspective, the results demonstrate that empathy-based interface design—integrating emotional awareness, adaptive multimodal feedback, and personalised zed pacing—plays a crucial role in improving accessibility and inclusion. The strong usability results and observed increases in engagement suggest that emotionally responsive systems can foster deeper learning experiences, especially for users who struggle with traditional instructional methods. Nevertheless, several limitations should be noted. The pilot sample was relatively small, and all sessions were conducted under controlled conditions. Future research should include longitudinal field studies with diverse populations and explore cross-linguistic validation for multilingual users. Additionally, integrating wearable sensors (e.g., wristbands measuring heart rate or skin conductance) could further enhance the emotional adaptivity of the system, allowing real-time physiological monitoring to fine-tune feedback. Future developments will focus on deploying the platform as a mobile and cloud-based application, enabling broader access for therapists, schools, and families. This aligns with the broader vision of inclusive AI in education, where digital tools are not merely intelligent but also empathetic and equitable. By bridging artificial intelligence, human-computer interaction, and assistive learning, this study contributes to shaping the next generation of emotionally aware, accessible, and personalised educational technologies.

Keywords: Human-Computer Interaction, Assistive Technology, Neurodiversity, Speech and Language Disorders, Human-Centred Design, Artificial Intelligence, Accessibility.

The Role of Expertise in Secure Code Review: An Eye-Tracking Study

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Abstract

Code review has been conducted both by humans and artificial agents, and it is developing as a necessary ICT skill for human code developers. The experience of developers in code review has remained an important skill due to its potential impact on software quality and performance. The present study employs eye tracking to reveal similarities and differences between novice and expert software developers who have experience in detecting software security vulnerabilities in code. Eye movements of twenty participants were recorded while they inspected program code for security review. The results suggest that eye tracking can be used to assess code review expertise in cybersecurity, as behavioural-level findings were complemented by insights from eye movement variables. Specifically, expert programmers made fewer fixations on the stimuli and detected vulnerabilities faster than novices. The findings also revealed the range of eye movement parameters that could be used for assessment, as alignment between behavioral performance and eye movement parameters was observed in total gaze durations but not in single fixation durations.

Keywords: Code Review Assessment, Software Security, Eye Tracking, Expertise in Programming, Gaze Analysis, Expertise

Evaluating VRChat Usability in Desktop Mode: A Student-Led Case Study on Social VR Platforms

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Abstract

Social virtual reality (Social VR) platforms such as VR- Chat have become prominent spaces for online interaction, yet academic research has focused predominantly on head-mounted display (HMD) experiences. This neglects the desktop mode, which accounts for approximately 70% of VRChat's user base. This study investigates the usability of VRChat's desktop mode from the perspective of undergraduate students, addressing three research questions:

(1) How do students perceive its usability? (2) What challenges or limitations do they encounter? (3) What improvements could enhance user satisfaction? Eighteen students from Software, Computer, and Mechatronic Engineering participated in a structured usability test comprising ten core tasks (e.g., avatar creation, world navigation, friend addition, and object interaction). Data were collected through demographic questionnaires, post-test surveys, and detailed researcher observation notes. Quantitative results revealed high ratings for visual design and enjoyability but lower scores for learnability, security, and error handling. Qualitative findings indicated recurring barriers in navigation, avatar customization, friend-adding, and object manipulation, compounded by performance issues such as low FPS and lengthy loading screens. Participants valued the platform's creative and social potential, yet reported frustration with unclear menus, limited onboarding, and inconsistent interaction feedback.

The results contribute to the underexplored domain of desktop-mode Social VR usability, complementing prior desktop VR research (e.g., [1,2,3]). Recommendations include improved in-app guidance, streamlined menu design, more accessible avatar customization, and optimization for non-VR hardware. These findings offer actionable insights for developers and inform the design of accessible, engaging Social VR experiences beyond HMD-centric paradigms.

Keywords: Social VR, VRChat, desktop mode, usability evaluation, user experience, virtual environments

Immigrant Learners' Interaction with Emotional Design Elements

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Abstract

Cognitive load theory describes how to deal with extraneous cognitive load resulting in inappropriate design elements. There are many guidelines, principles, and approaches to designing learning materials appealing to learners' needs. Emotional design is one of the approaches to improve the learning experience through the utilization of visuals, verbal, and other design elements. This study focuses on how emotional design elements affect the cognitive load of learners. The research pattern of the study is an explanatory sequential mixed-methods design. 109 primary school immigrant students participated in the study. Students were exposed to selected instructional materials on two national platforms. Eye movements, galvanic skin response, and heart rates were recorded as they watched the materials. The results indicated that the positive emotional elements mostly resulted in increases in fixation duration. This pattern disappeared when other types of elements were included, such as cultural, neutral, and negative emotional elements. The negative emotional design elements, such as a crying boy or a representation of a traffic accident, might cause the longest fixation durations. It was found that the heart rate has positive correlations with eye movement metrics, but the same pattern was not observed for galvanic skin response values.

Keywords: Emotional Design, Cognitive Load, CASTLE, Multimedia Learning.

Learning, Participation, and Communication Barriers in Voice Assistants for Adults 60+: A Uses and Gratifications Perspective

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Abstract

Voice-based artificial intelligence systems present a dual structure within today's educational and socio-technological paradigms: While these technologies have the potential to enhance human cognition, daily functionality, and social participation, they can also create cognitive, technological, and communicative barriers that complicate meaningful interaction, particularly for older adults. As digital technologies become an integral part of everyday life practices, understanding how aging individuals interact with these systems, how they learn, adopt, or reject them has become a critical area of research. Shaped by the Uses and Gratifications Theory (UGT), which views media users as active individuals who make conscious choices based on specific needs, this study examines how individuals aged 60 and over learn voice assistant technologies, the gratifications they expect from these technologies, and the communicative or cognitive limitations they encounter during the usage process.

The research is based on a qualitative case study design with the aim of revealing the multi-layered structure of the social, technological, and cognitive dynamics involved in the interaction between voice assistants and older adults. A multi-method data collection process was conducted, consisting of semi-structured interviews, pre-test–post-test applications, structured usage scenarios, brief observation notes, and reflective statements with 30 participants selected through purposive sampling to represent diverse demographic and technological backgrounds. The two-stage interview structure allowed for a comparative examination of participants' perceptions before and after their direct experience with the voice assistant, revealing changes over time in dimensions such as usage motivations, perceptions of ease and difficulty, sense of independence, social integration, and trust.

Preliminary findings indicate that older adults mostly position voice assistants as tools that reduce cognitive load. Participants viewed these technologies as a supportive element in functions such as reminders, information gathering, daily planning, and communication; however, barriers such as privacy concerns, lack of trust, concerns about correctly expressing commands, and perceived technological complexity limited

their intention to use the technology. Experiential scenarios revealed that direct interaction increased awareness in most participants, but issues such as communication breakdowns (misunderstood commands), difficulties interpreting system responses, and lack of digital literacy increased cognitive effort, reducing potential satisfaction.

The findings show that voice assistants have the potential to strengthen the sense of independence, confidence, and perceived social connectedness in older adults, but they can also complicate the user experience by creating unexpected cognitive demands. This dual structure clearly highlights the need for voice-based artificial intelligence systems designed to be sensitive to the sensory, cognitive, and communicative needs of older adults. Furthermore, the study demonstrates that UGT provides a robust theoretical framework for understanding how satisfaction-seeking and barriers to technology use co-shape older adults' technology usage.

This research contributes to the literature on ageing and human–artificial intelligence interaction, offering important insights for developing inclusive and accessible voice technology designs and improving strategies to increase the digital participation of older adults.

Keywords: Voice assistants, Ageing and Technology, Uses and Gratifications Theory, Human–Artificial Intelligence Interaction

Analysis of Motor Learning and Depth Perception through Tangram Gameplay: An HCI Perspective

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Abstract

This study investigates the Tangram puzzle game as a framework for examining depth perception and motor learning within the field of Human-Computer Interaction (HCI). Tangram, a traditional puzzle made up of geometric shapes, provides an engaging and adaptable platform to explore how interactive tasks foster cognitive and motor development. The research focuses on three objectives: first, to assess depth perception by analyzing how players manipulate two-dimensional (2D) shapes to construct perceptual representations of three-dimensional (3D) structures, thereby enhancing spatial cognition; second, to demonstrate the suitability of Tangram as a lightweight and flexible experimental tool for systematically measuring user interaction; and third, to examine motor learning processes through the repeated manipulation of puzzle pieces, offering insights into the refinement of fine motor skills and hand–eye coordination. By embedding Tangram gameplay into a structured experimental design, this work contributes to HCI scholarship by highlighting the value of puzzle-based interaction in understanding cognitive processes, informing interface design, and advancing interactive systems that support learning, rehabilitation, and skill development.

Keywords: Depth perception · Motor learning · Hand–eye coordination · Cognitive development

In-Service Teachers' Initial Experiences with the MIXAP Mixed Reality Authoring Tool

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Abstract

The MIXAP-EU project (2024–2027), funded by Erasmus+, aims to support in-service teachers in designing and implementing Mixed Reality (MR) learning experiences through a co-designed, open-source authoring tool. This study investigates teachers' initial experiences with the MIXAP tool, focusing on their perceptions, reported benefits and challenges, and suggestions for usability improvements to inform its ongoing development. Data were collected from four focus group interviews conducted during the first round of co-design workshops in France (11 teachers), Denmark (4 teachers), and Turkey (16 teachers), involving 31 participants across disciplines. Framed as a qualitative case study, the research examines the bounded context of early tool use during Erasmus+ workshops. Thematic analysis (Braun & Clarke, 2006) generated three overarching themes. First, teachers saw potential for AI to enhance MR authoring but raised concerns ranging from compliance (France) to accuracy (Turkey). Second, ease of use was identified as a universal priority, though expectations differed—emphasizing pedagogical alignment in France, visual engagement in Denmark, and structured onboarding in Turkey. Third, all groups highlighted the 2 importance of professional support, albeit in different forms: structured resources (France), peer networks (Denmark), and classroom-focused training (Turkey). These findings reveal both shared and context-specific needs, offering insights to guide the co-design and refinement of the MIXAP tool.

Keywords: Mixed Reality, Augmented Reality, Teachers' Experiences, In-service teachers.

Virtual Glasses And Virtual Museums in The Digital Transformation of Cultural Motifs: Experiencing Heritage in New Dimensions

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Abstract

Recent technological advances have introduced new methods for preserving and sharing cultural heritage. Virtual reality and virtual museums allow users to experience cultural motifs digitally. This study examines how advanced 3D scanning and modeling digitize traditional artworks, motifs, architectural features, and folkloric patterns. Using Meta Quest 3, we created a virtual gallery where users interact with these digitized motifs in an immersive environment. Our findings demonstrate that virtual museums enhance access to cultural heritage by eliminating physical and temporal barriers. At the same time, VR headsets offer interactive experiences that enhance cultural awareness and motivation to learn. The study highlights the potential of VR technologies for preserving, documenting, researching, and teaching cultural heritage. It demonstrates that digitizing regional motifs can enrich collective memory and support the transmission of cultural knowledge to future generations.

Keywords: virtual reality, virtual museums, cultural motifs, digital transformation, heritage, 3D modeling, cultural preservation

Evaluation Of The Performance Of Distinctive Object Detection And Camouflaged Object Detection Models Using Night Image Data

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Abstract

Object detection in nighttime images is a challenge that traditional object detection models struggle to solve due to insufficient light and ambiguities. Therefore, specific models for this domain are being designed and proposed in the literature. Numerous studies have demonstrated that traditional models are inadequate and unsuitable for this domain, but there are very few studies examining the performance of models developed for more specific tasks, such as distinct object detection (SOD) or camouflaged object detection (COD), and whether they can contribute to this field. In this study, different SOD and COD models were trained on a dataset containing nighttime images, and the results were evaluated. The results showed that camouflaged object detection models outperformed other models.

Keywords: Saliency object detection · camouflaged object detection · Object detection in night images.

Immersive Contact Geometry: A VR-Based Approach on Embodied Understanding of Legendrian and Transverse Knots

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Abstract

One of the main challenges to teaching advanced mathematics is understanding high dimensional geometric structures. Students' spatial understanding is limited by contact geometry's dependency on static 2D projections, which includes abstract concepts like Legendrian and transverse knots. The goal of this study is to present an immersive Virtual Reality (VR) environment that allows students to see and engage with three-dimensional contact manifolds and tight vs. overtwisted contact structures in them. To model contact planes and their relationship to Legendrian and transverse knots, a virtual reality learning environment was created by using Gravity Sketch. Participants in a pilot implementation explored knots in both standard and overtwisted contact structures under the instructors' supervision during a graduate summer school. Observations, informal interviews, and field notes were collected to capture student engagement and conceptual understanding. According to participants, the VR experience allowed them to "see" tangency, cusps, and invariants for the first time, turning abstract concepts into real-world experiences. By using this method, teachers were able to spot misconceptions that were previously undetectable in 2D environments. Even if the sample is small, immersive virtual reality holds great promise for use as a precision pedagogical tool that facilitates embodied and conceptual learning in advanced mathematics, rather than just as a visualization tool. Formal pre/post assessments will be used in future research to measure conceptual advancements and spatial reasoning.

Keywords: Virtual Reality, Contact Geometry, Legendrian and Transverse Knots, Mathematics Education, Spatial Visualization, Human-Computer Interaction

The User Behavior Differences on Interacting with Search Engine vs. Generative AI

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Abstract

This study aims to compare how the searchers' behavior changes while engaging in various search tasks in two contexts: Google search engine vs. ChatGPT. The tasks were categorized based on the level of complexity for both the searcher and the AI agent. Four tasks were used: (Task 1) Low AI-Low Searcher; (Task 2) Low AI-High Searcher; (Task 3) High AI-Low Searcher; and (Task 4) High AI-High Searcher. Fourteen voluntary users participated in the study. Screen and voice recordings were collected during task engagement. The results indicated that task complexity might affect information search dynamics. Users spent a longer time in ChatGPT for tasks that are highly complex for an AI agent, and the majority of them initiated the search process by modifying the task statements. For all tasks, the users relied on SERPs or suggestions generated by the system, but the reliance tended to decrease as the tasks became highly complex for the AI agent. The prompts used for all tasks were still similar to the keyword-like structure. The prompt changes were not observed in Task 1 and Task 4. Tasks that are less complex for the AI agent resulted in occurrences of all four types of navigation patterns. As the tasks became highly complex for the AI agent, the switchers and solo searcher navigation patterns emerged. Among all tasks, Task 2 was challenging for users, as the majority of them failed. For all tasks, users' expectations tended to find the exact answer within SERP or suggestions.

Keywords: Generative AI, ChatGPT, Information Search.

Evaluating Educational Apps for Neurodivergent Children Using Extended Heuristics and SUS Approach

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Abstract

Children with neurodivergent conditions such as Autism and Attention Deficit Hyperactivity Disorder (ADHD) often face challenges in early learning. Although various mobile applications exist to support education, most are not specifically designed with neurodivergent needs in mind. Some applications often lack neurodivergent-specific usability guidelines. This study aims to propose an extended set of heuristics developed from 83 design guidelines to evaluate the usability of educational applications developed for neurodivergent children. Three popular educational applications Otsimo, AutiSpark and MITA for neurodivergent children were selected which were evaluated using the proposed heuristics along with Nielsen's heuristics by three usability experts. The findings revealed that using the extended heuristics, 59 usability problems were found overall as compared to 45 problems found using only Nielsen's heuristics, indicating the effectiveness of the proposed heuristic set. The System Usability Scale (SUS) was used with eight parent participants acting as proxy users to complement expert-based evaluation. According to the results, AutiSpark had low usability (43.44%), MITA moderate usability (59.38%) and Otsimo excellent usability (81.25%). The findings highlight the effectiveness of the extended heuristics in identifying neurodivergent specific usability problems and the importance of combining expert and user-centered approaches to create inclusive and encouraging digital educational environments for neurodivergent children

Keywords: Neurodivergent · Usability Evaluation· Heuristics · Educational Application · SUS.

A Novel Biometric AI-based System on Hand Images Using Deep Learning Methods

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Abstract

In this paper, the main aim is exploring individual identification through Dorsal Hand Vein Patterns using different Deep Learning methods. This study delves into the biometric evaluation of human identification, capitalizing on the uniqueness of dorsal hand vein patterns. Feature extraction methodologies are validated through the Tecnocampus hand image dataset, concentrating on dorsal hand images. The research uses three distinguished Convolutional Neural Network (CNN) architectures, namely, ResNet-50, GoogleNet and SqueezeNet. Each offers unique feature extraction techniques and their performances are measured through application to a relevant dataset. The ensuing analysis enables the selection of the most potent features from each architecture. Employing the robustness of the evaluated CNN architectures and utilizing Euclidean distance measurement, the proposed strategy attains significant success in image recognition. The method measures similarity between dorsal images through feature vectors and feature vector similarities are assessed using the Euclidean distance. Consequently, this approach facilitates highly accurate identification and matching of hand vein patterns. With a commendable overall accuracy of 97.32%, this study could potentially revolutionize the domain of biometric identification, providing a solid groundwork for subsequent innovations.

Keywords: Biometric Identification, Convolutional Neural Network (CNN) Architectures, Dorsal Hand Vein Patterns, Euclidean Distance Measurement, Feature Extraction

Dark Patterns in E-Commerce: A User Study on Manipulative UX Design

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Abstract

The pervasive use of manipulative interface designs in e-commerce platforms has raised significant ethical concerns, as these so-called dark patterns subtly coerce users into unintended actions such as purchases, subscriptions, or data sharing. Despite their effectiveness in driving short-term conversions, these deceptive practices often leave users feeling frustrated and distrustful, ultimately harming long-term customer relationships. This research investigates the psychological and behavioral impact of dark patterns through a mixed-methods approach, combining controlled user experiments with in-depth surveys. Participants interacted with two versions of an e-commerce platform one employing common dark patterns (e.g., hidden costs, false scarcity, and confirm-shaming) and another adhering to ethical design principles. During these interactions, participants' operations are carefully observed while they complete standardized shopping tasks, with their experiences systematically recorded through post-task questionnaires. Findings highlight the tension between immediate business gains and sustained user trust, underscoring the need for more transparent and user centric design practices. By integrating expert heuristic evaluations with empirical user data, this research provides actionable insights for designers, policymakers, and businesses seeking to balance profitability with ethical responsibility in digital commerce. The outcomes advocate for stricter regulatory measures against coercive design while promoting frameworks that prioritize user autonomy and long-term engagement over deceptive short-term gains.

Keywords — Dark Patterns, E-Commerce, Manipulative Design, User Interface Design, User Behavior, Decision Making, Ethical User experience (UX), Heuristic evaluation, Questionnaires.

A Quasi-Experimental Evaluation of the Proliferation and Growth Intensity of Dark Patterns in E-Commerce Applications Across European Union Countries

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Abstract

This study evaluates the impact of the phased implementation of the European Union's Digital Services Act (DSA) on the prevalence and severity of dark patterns in the e-commerce sector. The DSA, which prohibits manipulative design practices beginning in 2023, provides a unique regulatory context to assess the effectiveness of legal interventions against deceptive interface tactics. Adopting a quasi-experimental panel design, we collected data from EU-based e-commerce websites between 2023 and 2025 and compared outcomes against a control group of comparable non-EU websites. To estimate causal effects, we employed both a difference-in-differences approach and an event-study framework. Furthermore, we developed a novel composite metric—the Dark Pattern Severity Index (DPSI)—which integrates three sub-indices: Consumer Autonomy Suppression, Cognitive Friction Intensity, and User Manipulation Index.

The findings indicate a significant decline in both the prevalence and severity of dark patterns among EU websites following the general enforcement date (17 February 2024), with no parallel change observed outside the EU. Reductions were strongest in sectors dominated by Very Large Online Platforms, while fragmented markets exhibited weaker effects. Evidence of substitution emerged, as overtly prohibited dark patterns decreased but subtler tactics such as framing and visual emphasis increased. Cross-country variation further revealed that stricter national monitoring correlated with sharper declines in DPSI. These results underscore the regulatory importance of robust auditing frameworks and introduce new methodological tools for future research on online consumer protection.

Keywords: Dark Patterns; Digital Services Act ; E-commerce; Dark Pattern Severity Index; Difference-in-Differences; UX regulation; European Union

TRedDil: Revealing Systematic Language Bias in LLM Safety

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Abstract

As large language models (LLMs) become increasingly integrated into real-world applications, ensuring their ability to avoid producing harmful or unsafe outputs has become a central concern. However, most existing safety evaluation datasets are designed for English, leaving substantial gaps for other languages. To address this limitation, this work presents TRedDil (*Türkçe Reddedilmesi Gereken Dil Sorguları – Turkish Queries That Should Be Refused*), a dataset for assessing refusal behavior in Turkish. TRedDil is a faithful Turkish translation of the *Do Not Answer* dataset and preserves its original risk categories. Evaluation of 19 diverse models using an LLM-as-a-judge framework reveals three key findings: First, 84% of models exhibit significant language-dependent safety bias, with English refusal rates exceeding Turkish by 6–37 percentage points. Second, models differ substantially in safety strictness within each language, with refusal rates ranging from 28.8% to 87.0%. Third, while 65% of model×category pairs show significant bias, the bias magnitude is consistent across risk domains rather than category-specific. Notably, even Turkish-finetuned models demonstrated significant English bias, indicating that language adaptation without parallel safety realignment preserves English-centric mechanisms. TRedDil provides a critical resource for the Turkish NLP community and reveals systematic challenges in multilingual safety alignment.

Keywords: LLM Safety, Refusal Evaluation, Multilingual Safety, Language Bias, Cross-Lingual Evaluation, Low-Resource Languages, Safety Benchmarks, Dataset Localization, Turkish NLP

Life Cycle Assessment of Tablets: Environmental Impact Analysis and Sustainability Results

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Abstract

The environmental impact of tablets causes a number of environmental problems during their production, processing and disposal. A large amount of plastic, metal and chemicals are used during production, and high carbon dioxide emissions increase air pollution. The batteries and electronic components inside tablets release hazardous substances into the soil, water and ecosystem if not disposed of properly. The increasing demand for tablets with the introduction of paperless technology around the world, especially the expansion of their use in higher education institutions, makes the issue of studying the environmental impact of tablets even more relevant. From this point of view, the article presented considers the issue of assessing the life cycle of modern tablets "from start to finish" for a period of 5 years in accordance with the ISO 4040:2006 and ISO 14044:2006 standards. At the same time, the environmental impact at all stages of their life cycle is quantitatively assessed and certain recommendations are given in terms of improving the environment by comparing them with other devices. The study found that the average life cycle carbon footprint of a 600g tablet, taken as a functional unit, is 156 kg CO_2e (31-39 kg per year), which is approximately twice the annual carbon footprint of a mobile phone. This is 1.8 times and 4.4 times lower than that of a laptop and a desktop, respectively. Sustainable and environmentally friendly manufacturing processes, recycling and the use of innovative materials can help reduce the environmental impact of tablets. While tablets still have the lowest carbon footprint compared to laptops and desktops, to reach the tipping point of carbon neutral production, this study shows that manufacturers need to find more environmentally friendly manufacturing methods that will reduce the carbon footprint of a product below 112.8 kg CO2e.

Keywords: life cycle assessment, tablet, higher education, environment, carbon footprint, carbon emissions, sustainable electronics

The Role of Automotive User Interface in Achieving the Sustainable Development Goals

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Abstract

The Sustainable Development Goals (SDGs) of the United Nations represent a global agenda to promote sustainable development. As the automotive industry continues to evolve through technological innovations, there are also a growing number of possibilities for the con- ception and design of the User Interface (UI). This paper examines the role of the UI in supporting the SDGs in all dimensions social, environ- mental, and economic. In a three-step process, the SDGs are analyzed, in- cluding an evaluation of the relevance to UI through an expert interview. Experts, drawn from interdisciplinary elds (e.g., medicine, education, and ecology), evaluated the potential impact of the UI design on indi- vidual SDG indicators. The results presented highlight which goals can be particularly promoted through targeted UI design. In addition, initial design approaches are collected. The study underscores the potential of user-centered UI as a tool to achieve sustainability in all dimensions and discusses an interdisciplinary research approach to this topic.

Keywords: Interior Design Engineering Design for Sustainability Interdisciplinary Research User-Centered Design.

A Mobile Application Using a Low-Cost EEG Device for Real-Time Stress Detection to Support Mental Well-Being

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Abstract

Nowadays, increasing workload, fast-paced lifestyles negatively affect individuals' mental well-being by increasing stress. However, effective technological solutions for stress management are often inaccessible due to high costs and processing power requirements. This study presents a low-cost mobile recommendation application capable of stress detection in real time using electroencephalography (EEG) data from a single-channel NeuroSky MindWave Mobile 2 device. The application analyzes the data with low processing power to assess stress levels and provides personalized relaxation suggestions such as music, breathing exercises, or meditation. Furthermore, a user study with 28 participants revealed that EEG based measurements and self-reported scores of State-Trait Anxiety Inventory (STAI) reflected users' stress levels in a similar way. Additionally, user experience evaluation of the application revealed high perceived usability and a generally positive interaction experience based on UMUX-Lite score of 86.31 and AttrakDiff score of 1.89. These findings suggest that the application can support mental well-being through accessible, real-time stress detection and interactive feedback mechanisms. In addition, the results highlight the potential of EEG-based mobile technologies in promoting emotional wellness and offer a promising example of user-centered design for quality-of-life enhancement.

Keywords: Stress Detection, Mental Well-Being, EEG, Mobile Application, User Experience (UX), UX Evaluation, Neurosky MindWave.

Usability Evaluation of Mobile Banking Applications Among Older Adults

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Abstract

This study investigates the experiences and challenges faced by older adults when using mobile banking applications. In today's context, a significant portion of financial transactions are conducted via mobile devices, which can pose considerable challenges, particularly for individuals with limited digital literacy. Therefore, this study is important in terms of facilitating older adults' access to banking services and promoting financial inclusion. Twelve elderly individuals enrolled in the “Internet Banking and Internet Shopping” course at Sinop University Third Age University participated in the study. Participants were given nine tasks to complete using the mobile applications of four different banks. These tasks included routine banking operations such as checking account balances, transferring money, paying bills, performing credit card transactions, and configuring security settings. Throughout the task completion process, the research team used observation forms. At the end of the study, the System Usability Scale was applied, followed by semi-structured interviews with the participants. The data obtained were analyzed using descriptive statistics for quantitative data and content analysis for qualitative data. The findings highlighted the key areas experienced by seniors when using mobile banking and identified their needs regarding mobile banking usage.

Keywords: Digital Literacy, Mobile Banking, Older Adults, System Usability, Third Age University.

Comparative study of Web3 vs Web2 Social Media: Evaluating UX and Determining Impactful UX Parameters

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Abstract

Web3 social media applications are decentralized applications built on blockchain technology, while Web2 social media apps are centralized platforms controlled by a single entity. With this technological shift, the question of whether Web3 social media applications will be adopted by users remains open. To examine real user interaction and usability across these two paradigms, the user experience (UX) of a representative Web3 platform and a Web2 platform was evaluated using nine key UX parameters in a head-to-head comparison. A user study with 20 experienced social media users was conducted, followed by a System Usability Scale (SUS) evaluation. Partial Least Squares Structural Equation Modeling (PLS-SEM) was then used to capture the complex relationships among the UX parameters and to test the hypotheses. In comparison, the Web2 app achieved a SUS score of 87.5 (Excellent), while the Web3 app recorded a score of 35 (Awful). Further, it was indicated by PLS-SEM that all nine parameters are salient in Web3, while perceived control and perceived value are comparatively less central in Web2.

Keywords: Web3, Web2, Decentralized social media, UX (UX), System Usability Scale (SUS), PLS-SEM, Structural Equation Modeling, Usability, Comparative Study, User Adoption

Designing a Gamified Mobile Application for Cognitive Support

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Abstract

This study aims to support cognitive abilities and mitigate cognitive decline through the development of a mobile application for adults who are at risk of dementia or seek to maintain their cognitive functions. Findings from similar studies in the literature indicate that smartphone applications can be an effective tool for enhancing cognitive functions in older adults and suggest that such technologies could be incorporated into dementia prevention programs at the societal level. These findings reveal the potential of digital technologies to support cognitive capacity in older individuals and to mitigate the effects of dementia. Moreover, achieving high usability in the mobile applications to be developed is critical for adoption by the target audience and for integration into daily life. Accordingly, in this study, a gamified mobile application is designed to support cognitive functions through interactive and engaging mini-games. The application consists of three cognitive training modules, each targeting different aspects of memory, attention, and perception. In order to better understand the usability, engagement, and perceived cognitive benefits of the system, mixed-methods pilot study was conducted with two cohorts (adults 18–65 and adults aged over 65). In this pilot study, participants played three games on mobile environment: Geometric Object Matching, Card Matching and Word Completion. Performance metrics for each trial such as accuracy, time-to-complete, error counts for the given tasks were recorded. Additionally, the usability of the mobile application was assessed using a standardized system usability scale (SUS) questionnaire in Turkish. The results of this study indicate that gamified mobile applications demonstrate high usability, supporting their viability for broader deployment and long-term use in cognitive support interventions.

Keywords: HCI, Mobile Application, Gamification

Development and Usability Evaluation of A Secure Payment System for Visually Impaired Individuals

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Abstract

Despite significant technological advancements, visually impaired individuals still face major challenges in independently conducting financial transactions due to barriers like insufficient feedback, poor color contrast, fraud, and a lack of appropriate tools. This study presents **Cashify**, a mobile application designed to enhance accessibility by enabling secure and accurate payment processes for visually impaired users. Cashify incorporates three major functionalities that users can execute and combine in case they experience complex shopping scenarios: vocalization through recognition of payment amounts on POS machines, vocalization by recognizing banknote amounts and real-time change verification via camera for cash payment validation, and text-to-speech technology for reading receipts. Developed through an iterative design process, Cashify's performance was tested for precision on recognizing payment materials during distinct use cases and perceived usability with three visually impaired participants. Results demonstrate relatively high recognition precision (85%, %83 and 74.2%) for recognizing amount on receipts, POS screen and banknotes, respectively, and a high overall perceived usability (a mean SUS score of 83.3 ± 2.9), highlighting Cashify's potential to address accessibility challenges in financial transactions. Future work will focus on further usability enhancements and expanding features.

Keywords: Accessibility, accessible payments, visually impaired, payment security, cash recognition, Text-to-Speech Technology, mobile application, financial independence.

Mobile Application-Supported Instructional Design in Anatomy Education

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Extended Abstract

Vocational anatomy education presents a significant pedagogical challenge, characterized by high cognitive barriers for students. In disciplines such as equine studies, learners must assimilate a large volume of spatially complex information, further complicated by unfamiliar Latin terminology [1]. Traditional instructional methods, often reliant on lectures and static 2D materials, can impose a high cognitive load, leading to decreased student motivation, poor knowledge retention, and low success rates [1]. This issue is not merely a content-difficulty problem but a fundamental Human-Computer Interaction (HCI) challenge related to information presentation and cognitive processing. This study addresses this challenge by investigating how an instructional redesign, incorporating a 3D interactive mobile application, can mitigate cognitive load and enhance learning outcomes.

The effectiveness of the instructional intervention is grounded in established theories of human cognition and interaction design. This framework provides the scientific rationale for why the mobile application-supported approach was expected to succeed where traditional methods falter.

The instructional design is fundamentally informed by Richard Mayer's Cognitive Theory of Multimedia Learning [2]. This theory posits that meaningful learning occurs when instructional materials are designed in alignment with how the human brain processes information, particularly by reducing cognitive load [3]. The theory is based on three core assumptions: the dual-channel assumption (visual and auditory information are processed separately), the limited-capacity assumption (working memory can only process a finite amount of information at once), and the active-processing assumption (learners actively construct knowledge) [4]. The mobile application and its integration into the lesson were designed to leverage several key principles derived from this theory:

- Multimedia Principle: Students learn more deeply from words and pictures together than from words alone [2]. This is

grounded in dual-coding theory, which suggests separate channels for processing verbal and visual information [5].

- Spatial Contiguity Principle: By placing anatomical labels directly on or adjacent to their corresponding parts on the 3D model, the application reduces the cognitive effort required to link visual information with verbal identifiers [2]. This is critical for developing a robust understanding of complex spatial relationships in anatomy [2].
- Segmenting Principle: The application's user-paced, interactive nature allows learners to control the flow of information, exploring segments at their own pace [4]. This prevents the cognitive overload that can occur with a continuous, instructor-led presentation of complex material [6].
- For a cognitively sound tool to be effective, it must also be highly usable, especially in a mobile context. The success of this intervention is a product of the synergy between cognitive principles and core HCI principles for mobile interaction. The chosen application aligns with best practices for mobile learning design:
- Simplicity and Learnability: The application features an intuitive interface with direct manipulation controls (e.g., pinch-to-zoom, swipe-to-rotate). This high learnability, a core principle of usability engineering, minimizes the extraneous cognitive load associated with learning a new tool, allowing students to focus on the anatomical content itself [7, 8].
- Chunking Content for Microlearning: Mobile learning is most effective when content is delivered in short, focused bursts, an approach often called microlearning [9]. This aligns with learning theories designed for the mobile age, which emphasize context and accessibility [10].

Method

This study employed a design-based research methodology, an iterative approach involving the analysis of a practical learning problem, the design of a theory-based intervention, and its evaluation in a real-world educational context. The research was conducted with second-year students in the Horse Riding and Coaching program at a vocational college in Turkey.

An initial needs analysis, involving surveys and semi-structured interviews with nine students from a previous cohort, identified key learning challenges, including the abstract nature of the content and a lack of engaging visual materials. Based on these findings, a two-week instructional intervention was designed and implemented with a new cohort of eight students (N=8), integrating the "3D Horse Anatomy Software" mobile application into the course. The development of this intervention followed the ADDIE instructional design model, encompassing Analysis, Design, Development, Implementation, and Evaluation phases.

A mixed-methods approach was used for evaluation. A pre-test/post-test design with identical paper-based exams (covering the same learning objectives) was used to measure student achievement in anatomical knowledge. Following the intervention, semi-structured interviews were conducted with four volunteer participants to gather qualitative feedback on the learning experience; these interviews were recorded, transcribed, and analyzed using thematic analysis to identify key themes. The study protocol was approved by the institutional ethics committee, and all participants provided written informed consent prior to their involvement. Data were analyzed using a paired-samples t-test for the quantitative results and thematic analysis for the qualitative interview data.

Results

The mobile application-supported instructional design led to a significant improvement in student learning outcomes.

- Quantitative Findings: The mean score on the anatomy knowledge test increased from 36.38 (SD = 22.99) on the pre-test to 66.75 (SD = 30.49) on the post-test. A non-parametric Wilcoxon signed-rank test confirmed that this increase was statistically significant ($Z = -2.52$, $p = .008$), indicating a substantial enhancement in student achievement.
- Qualitative Findings: Thematic analysis of student interviews corroborated the quantitative results and provided insight into the learning experience. Key themes included:
- Enhanced Visualization and Comprehension: Students reported that the interactive 3D models made abstract anatomical concepts concrete and easier to understand. One participant noted, "...seeing the location of the bones in 3D in the application... increased the permanence and effectiveness of the lesson."
- Increased Engagement and Motivation: The interactive and visual nature of the lesson was perceived as more "engaging" and "fun" than traditional lectures, which boosted student motivation and attention.
- Improved Knowledge Retention**:** Students felt the multi-sensory experience facilitated by the app led to more durable learning. As one student explained, "since it appeals to more sensory organs and I think I can learn better with my visual memory, I believe this lesson is efficient and permanent."

Discussion

The findings demonstrate that an instructional design grounded in cognitive and interaction principles can effectively address long-standing challenges in anatomy education. The significant improvement in test scores can be attributed not just to the introduction of technology, but to the specific ways in which the mobile application helped facilitate active knowledge construction, as predicted by the Cognitive Theory of Multimedia Learning [2]. The specific focus on managing cognitive load is a key element of this success [6]. The

qualitative data strongly support this interpretation, with students explicitly linking the 3D visualizations and interactivity to their improved understanding and retention.

The primary limitation of this study is its small sample size (N=8), which restricts the generalizability of the findings. Future research is needed to validate these results with larger, more diverse student populations across different institutional contexts. Furthermore, this study did not include a formal usability evaluation of the mobile application. Future work should incorporate established HCI methods, such as the System Usability Scale (SUS) [11] or heuristic evaluation [12], to quantitatively assess the user experience and its relationship to learning outcomes. Finally, comparative studies are warranted to explore the relative effectiveness and cost-benefit trade-offs of this mobile application-supported approach versus other emerging technologies like Augmented Reality (AR) and Virtual Reality (VR) in anatomy education.

Recent systematic reviews [13] and meta-analyses [14] confirm that immersive technologies like AR and VR can yield significant learning gains in anatomy education. These technologies offer powerful, engaging learning experiences. However, they often require specialized hardware, significant development costs, and technical support, which can be barriers to widespread adoption, particularly in vocational or under-resourced settings. This study contributes a crucial piece to this landscape. It provides evidence that a well-designed, cognitively informed, and highly accessible mobile application running on students' own devices can also produce substantial learning improvements. This demonstrates a practical, scalable, and sustainable model for technology integration that can have a broad impact on education.

Conclusion and Contributions

This study demonstrates that a mobile application-supported instructional design, framed by principles of multimedia learning and mobile interaction, can significantly improve student success, engagement, and knowledge retention in a challenging vocational anatomy course. By transforming abstract, text-heavy content into a concrete, interactive, and multi-sensory experience, the intervention effectively mitigated cognitive barriers to learning. The primary contribution of this work to the field of HCI in education is its provision of empirical evidence for a sustainable and scalable model of technology integration. It offers a validated case study of how applying foundational cognitive and HCI principles can solve persistent pedagogical problems, providing a practical blueprint for user-centered instructional design in specialized domains.

Keywords: Mobile Learning, 3D Visualization, Equine Anatomy, Anatomy Education, Instructional Design.

Comparative Analysis of User Experience and Preferences in Authentication Solutions: Google SSO versus Traditional Email-Based Method

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Abstract

First-time authentication, the process of simultaneous signup and the first sign-in, plays a central role in determining user engagement, subjective security, and general satisfaction with online services. Although third-party Single Sign-On (SSO) approaches such as Google SSO are ubiquitous, comparative empirical tests of the effectiveness of such solutions compared to classic email-password registration under a controlled within-subjects design are few. In this study, 30 participants completed both Google SSO and email–password flows on a custom-built web site. We quantitatively assessed efficiency (task completion time), effectiveness (error rate), and subjective experience (usability, perceived security, trust, and satisfaction). The results show Google SSO reduced average completion times by nearly an order of magnitude and error rates almost by 97 % without substantially sacrificing perceived security or trust but enhancing usability and satisfaction. Qualitative comments also informed privacy concern trade-offs, context-specific preferences, and perceived ease of federated login. These findings suggest that integrating Google SSO can dramatically streamline user onboarding, reduce support costs, and enhance user experience, providing actionable insights for human-computer interaction (HCI) practitioners.

Keywords: HCI · User Authentication · Single Sign-On (SSO) · Google SSO · Email–Password Authentication · User Experience Evaluation · Perceived Security.

Immersive Learning in Biology: The Effects of Augmented Reality on Motivation and Academic Achievement”

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Extended Abstract

The use of technology in education transcends the limitations of traditional teaching methods by providing students with multimedia resources, interactive content, and personalized learning experiences; thus creating a dynamic pedagogical environment that adapts to different learning styles and individual needs (Roy, 2019; Sani et al., 2024). In this context, academic studies point to the need to develop interactive educational materials in line with instructional design principles in order to design effective teaching processes on mobile learning and e-learning platforms (Dung & Khanh, 2024; Huang et al., 2019). The literature reveals that learning materials and instructional resources are rapidly changing and transforming in line with the requirements of 21st-century skills demanded by the age of information and technology. This transformation shows that 21st-century educational technologies such as Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), educational games, mobile learning, and cloud-based technologies occupy a critical position among individualized virtual education solutions (Huang et al., 2019). In this process, AR technologies stand out as an innovative pedagogical tool by bridging learning experiences between the physical and digital worlds, concretizing abstract concepts, increasing student participation, and enriching multimedia-supported learning environments (Pochtoviuk et al., 2020).

This study aims to investigate the impact of augmented reality (AR)-supported instruction on high school students' academic achievement and motivation in the “Nervous System” unit of the 11th-grade biology curriculum. AR materials were developed for topics related to the nervous system, endocrine system, and sensory organs, incorporating 3D interactive virtual models. These materials were implemented in biology classes across three different types of independent high schools. A mixed-methods explanatory design was employed. The data collection tools included an academic achievement test, a biology course motivation questionnaire and a semi-structured interview form. The study sample consisted of 198 11th-grade students from one Science High School (Experimental Group: 53, Control Group: 55), one Anatolian High School (Experimental: 27, Control: 29), and one Vocational High School (Experimental: 19, Control: 15) in Erzurum, Turkey. Random assignment was used within a quasi-experimental paired group design. Quantitative measures were applied before and after the intervention, and qualitative data were collected through student interviews to explain the observed outcomes. The research

process lasted 8 weeks. The motivation scale was administered before and after the research, while the academic achievement and interview form were administered at the end of the research.

According to the results of the academic achievement tests, it was found that the results of Anadolu High School showed a normal distribution based on the Kolmogorov-Smirnov and Shapiro-Wilk tests, and the results of the Science High School and Vocational High School showed a normal distribution based on the Skewness and Kurtosis tests. When the independent samples t-test results were examined, a statistically significant difference was found between the Science High School students' experimental ($\bar{X}$=76.85, ss=17.29) and control groups ($\bar{X}$=83.04, ss=14.79) (t=1.90, p=.049). However, the low effect size (Cohen's d = −0.39) indicates that this difference has a limited practical impact. On the other hand, the findings regarding Anatolian High School students reveal a highly significant difference between the experimental ($\bar{X}$=65.81, ss=15.65) and control groups ($\bar{X}$=42.21, ss=23.09) (t=−4.44, p<.001). The high effect size (Cohen's d=1.19) of this difference indicates that the intervention had a strong and significant effect on Anatolian High School students. Therefore, it can be said that the effect of the intervention used in the study differed according to school type and had a higher level of effect on Anatolian High School students in particular. Since the number of students in the Vocational High School was small, the Mann-Whitney U test was used in the academic achievement test analysis. The control group's scores were found to be significantly higher than those of the experimental group (U = 66.000, z = -2.655, p <.05). These findings indicate that there is a significant difference between the control and experimental groups and that the control group has higher rankings than the experimental group.

The pre- and post-test motivation survey data were analyzed using the Wilcoxon signed-rank test when applying the dependent sample test to the Science High School and Anatolian High School, while the experimental and control groups at the Vocational High School were analyzed using the same test. According to the dependent sample t-test results for the Science High School, no significant effect was observed in the control group, while a moderately significant effect was observed in the experimental group (Control t(54) = .21, p = .835; Experimental t(53) = 2.33, p = .024, d = .35). According to the results of the dependent sample t-test for Anatolian High School, no significant effect was observed in the control group, while a moderately significant effect was observed in the experimental group (Control t(29) = .80, p = .15; Experiment t(27) = 2.18, p = .044, d = .53). According to the results of the Wilcoxon signed-rank test applied to the vocational high school, no significant effect was observed in the control group, while a high effect was observed in the experimental group (W = 10.00, p = .14, Cohen d = .78).

The results showed a statistically significant increase in academic achievement for the experimental group in the Anatolian High School, but no significant differences were observed in the Science and

Vocational High Schools. However, in all three school types, AR-supported learning significantly enhanced students' motivation in the course. These findings suggest that the integration of AR applications into biology instruction has the potential to improve students' engagement and psychological readiness for learning, particularly by enhancing their focus and motivation within the classroom context.

Keywords: Augmented Reality, Academic Achievement, Motivation

A trend analysis of 174 MITx MOOCs with a total of 3,523,692 learners on course categories, course levels, and learner demographics

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Abstract

Massive open online courses (MOOCs) have become a vital part of modern education, offering opportunities for learners worldwide from diverse backgrounds. Since their surge in popularity in 2012, millions of MOOCs are now available from various institutions. Despite extensive research on MOOCs, a comprehensive overview of their trends across different dimensions remains limited. This study analyzes 174 MITx MOOCs from 2012 to 2016, involving 3,523,692 learners, to identify patterns in course categories, levels, and demographics such as age, education, and gender. Results indicate that learners actively use MITx to further their education, with increasing enrollment in advanced courses reflecting positive educational progression. Younger and less-educated learners tend to progress more slowly, especially when moving to more challenging courses. Overall, MITx effectively supports lifelong learning by accommodating a wide range of ages and educational backgrounds, allowing learners to progressively enhance their knowledge. The integration of artificial intelligence into MOOCs holds potential to further amplify their impact, enabling more personalized and blended learning approaches within existing educational frameworks.

Keywords: Massive open online course, Trend analysis, Course category, Course level, Learner demographics, MOOC

Beyond Headsets: A Pragmatic Framework for K–12 VR Adoption—Bridging Pedagogy, Access, and Institutional Readiness

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Abstract

Virtual reality (VR) has transitioned from research laboratories into mainstream classrooms, yet adoption in K–12 education often falters because schools lack pragmatic scaffolds to transform technological potential into sustainable practice. Many initiatives remain confined to pilots or device trials, with little evidence of long-term pedagogical or institutional impact. This paper synthesizes findings from a targeted review of 11 peer-reviewed studies (2019–2024) and a comparative analysis of VR editors within K-12 settings to identify the barriers and enablers shaping adoption. Evidence is organized across five domains—technological infrastructure and hardware; pedagogical approaches and instructional design; institutional strategies, policies, and ecosystems; content development and curriculum integration; and accessibility, user experience, and data governance— highlighting trade-offs between accessibility, performance, authoring flexibility, and pedagogical depth. Building on this synthesis, the paper introduces STEP In XR, a practice-first framework comprising six interdependent levers: Safety, Privacy & Data; Technical Fit & Total Cost; Ecosystem & Policy; Pedagogy & Assessment; Inclusiveness & Accessibility; and eXpeRience Design & Teacher Workflow. The framework is operationalized through a 12-item XR Readiness Rubric (XRR-12) and a vendor/editor checklist, both of which translate research into measurable readiness indicators for use at the classroom, school, or district level. An accompanying Implementation Playbook (Plan → Pilot → Review → Scale) provides a phased roadmap to align adoption with assessment, inclusion, cost planning, and institutional strategy. The contribution is a coherent, actionable pathway that helps schools move beyond device trials toward systemic, measurable impact—positioning VR as pedagogy and institutional practice rather than spectacle.

Keywords: Virtual Reality, Virtual Reality Editor, K–12, Immersive Learning, Assessment, Accessibility, Data Privacy, Readiness Framework, Instructional Design, HCI.

Why Are People More Willing to Trust ChatGPT Than One Another? A Socio-Psychological Perspective on Trust

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Abstract

The paper explores trust in ChatGPT and anthropomorphism, with a focus on social psychology and human-computer interaction. Although rulebased, ChatGPT is increasingly described as an interlocutor, endowed with anthropomorphic characteristics, and perhaps trusted more than many of us. The purpose of the research is the researchers' attempt to find out why ChatGPT seems "more convenient" than human-critical talking: ChatGPT is more gracious and makes you feel comfortable, as ChatGPT's tone is, in fact, right. In the experiment involving 158 participants, respondents rated identical pieces of advice attributed to either a human or ChatGPT, where the latter was presented in either a neutral or an anthropomorphized form. The findings raise an interesting question: do people trust the machine simply because it is smart and helpful, or because it does not have limitations inherent in human communication? And is the predilection to anthropomorphize AI a symptom of a deeper societal ill – the shortage of trustful relations, the increase in loneliness?

Keywords: Anthropomorphism, Emotional Compensation, Digital Communication, Social Anxiety, Mediator Effects, Moderation, Regression Analysis.

Work Experience and Trust in AI: A Mixed-Methods Investigation Across Professional Backgrounds

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Abstract

Trust in artificial intelligence (AI) is a significant factor in how individuals embrace and evaluate intelligent systems throughout their personal and professional lives. However, varied levels of experience may impact people's views and evaluation of AI performance. This study examines the relationship between professional experience and trust in AI.

The research is conducted via three main stages. In the first stage, a survey examines the influence of experience on AI trust for professional and personal applications. Two populations were used: participants who were young and lacked professional experience and professionals with varying levels of experience. The objectives were to gain a baseline level of trust and identify patterns across experience levels, which compares the level of trust toward AI in personal versus professional tasks. This phase questions whether the differences are caused by digital literacy, bias, or experience, therefore the second phase was conducted.

The second phase is a blind test, where five professional groups—radiology, psychology, programming, mathematics, and research—are asked to judge AI-generated answers without knowing where they are from. The answers are from two tasks with different level of difficulty and each respondent is asked to which they are trusting of each answer. This phase investigates whether increasing task difficulty affects trust in AI-generated answers, and whether the absence of AI labels makes the level of trust closer to the initial survey results. During phase three, thematic analysis and follow-up interviews are conducted on participants with low trust ratings in an attempt to identify underlying reasons for their distrust.

The findings reveal a consistent negative correlation between experience level and trust in AI, with experts reporting lower confidence in AI recommendations compared to novices. Inferential analyses further demonstrate that these differences are statistically significant, indicating that experience not only shapes expectations but also moderates users' reliance on automated decision-making. The study highlights important implications for AI system design, suggesting that trust calibration strategies must be adapted to user expertise to avoid both over- and under-reliance.

Keywords: Artificial Intelligence Trust, Experience Correlation, Technology Adoption.

FLUXAI: Layered Explainability for Human-Centered Understanding via Feynman's Approach

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Abstract

The need for explanations that are both technically correct and cognitively meaningful to a wide range of users has been highlighted by the rapid spread of Artificial Intelligence (AI) in high-stakes fields like healthcare, finance, and law. The current Explainable AI (XAI) techniques, such as saliency maps, feature importance scores, and coun terfactuals, are still primarily model-centered and frequently fall short in bridging the gap between technical transparency and human com prehension. In order to overcome this constraint, we present FLUXAI (Feynman-inspired Layered User-centered eXplainability), a conceptual framework based on Richard Feynman's explanation pedagogy, which prioritizes active participation, progressive elaboration, and simplicity. Through the help of five integrated components — (1) an adaptive ex planation engine, (2) a pedagogical planner, (3) an analogy and exam ple generator, (4) an interactive interface, and (5) an uncertainty-ethics panel — FLUXAI converts raw outputs of XAI methods into layered, in teractive, and user-adaptive explanations. Beyond technical validity, we propose a multi-dimensional evaluation methodology incorporating simu lability, teach-back accuracy, trust calibration, decision quality, cognitive load, and fairness perception. Potential uses in recommender systems, healthcare, and finance highlight the advantages and disadvantages of this strategy, including the potential for oversimplification, cultural vari ation, and explanation abuse. With the help of redefining explainability as an interactive process of learning and trust-building that promotes transparency, intelligibility, and equity in AI systems, this work offers a theoretical synthesis connecting XAI with cognitive psychology, educa tion science, and HCI, a novel Feynman-inspired architecture for layered and pedagogically grounded explanations, and an evaluation agenda for human-centered AI.

Keywords: Explainable Artificial Intelligence, Human-Centered XAI, Feynman Technique, User Experience, XAI, Human-Computer Inteface

An Architecture for Real-Time Conversational Analytics on IoT and Enterprise Systems in Public Transportation

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Abstract

Public transportation systems, the Internet of Things (IoT), Enterprise Resource Planning (ERP) Systems, and operational databases generate heterogeneous data; however, traditional analytical approaches may be insufficient to provide accessible insights to non-technical personnel. This study addresses the use of real-time IoT data integrated with enterprise systems for conversational analytics in public transportation. This study attempts to fill the gap in the literature by integrating real-time IoT data with enterprise systems using Large Language Model (LLM) to provide a big data infrastructure for the application of conversational analytics in public bus transportation systems. An eight-layer architecture combined with a five-layer Retrieval Augmented Generation (RAG) framework designed for on-site deployment is proposed. The architecture addresses three design requirements: protocol heterogeneity to integrate various communication mechanisms (MQTT, HTTP, and others), temporal synchronization to correlate high-frequency telemetry with low-frequency enterprise updates, and semantic consistency to reconcile terminology variations across systems. The dual-path routing strategy aims to improve performance and cost, ensure accuracy, and validate results by directing routine queries to lightweight language models (LLaMA-3.1-8B) and complex analyses to heavy-duty models (LLaMA-3.1-70B). The system processed Turkish queries using specialized language analysis for transportation terms. Evaluation showed response times of 682-754 milliseconds (ms) with a 78.6% confidence interval and a P95 latency of 1247 ms. The architecture's open-source components, modular design, and distributed scalability aim to enable public transportation companies to maintain data sovereignty through internal infrastructure while utilizing conversational analysis.

Keywords: RAG Architecture, Human-computer interaction, Natural language processing, Artificial Intelligence (AI), Intelligent Transportation Analytics, Conversational Analytics.

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