

## ICONS AS COGNITIVE-SEMANTIC MORPHEMES IN URDU EDUCATIONAL INTERFACES: CROSS-CULTURAL INTERPRETATION, LINGUISTIC DETERMINISM, AND PEDAGOGICAL IMPLICATIONS

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### **Abstract**

*This paper examines icons as the unit of meaning in Urdu educational interfaces. It looks into the functionality of visual symbols in learning applications, e-books and online learning portals. Based on concepts about educational signs, language that forms thought and design of various cultures, the study examines the impacts of icons on the comprehension, the place of where the Urdu learners gaze and meaning by the learners. The research draws a combination of experimentation done with 120 students, eye-tracking, cross-cultural comparison, and an overview of 25 education websites. It examines the way icons are read by people depending on their position, the use of Urdu words, and culture. We discovered that icons are like bricks. Their meanings are clear, they operate with language in systematic ways and are interpreted differently in a given culture. The point is that the icons are read differently by Urdu speakers in comparison with the West users. The reason is that word structure, right-left writing, as well as word groups in Urdu, affect the thinking of people regarding pictures. We demonstrate that in Urdu websites, right-sided icons are given more focus as compared to English websites that favour left side icons. The work indicates that universal design presupposes that the icons are obvious at all times, whereas the actual comprehension must rely on the language habits, culture, and the school environment. Four major types of icons are found, namely representational icons which depict actual objects, operational icons which initiate actions, organizational icons which order content, and modal icons which depict learning modes or states. The research contributes to the body of knowledge on education technology that recognizes culture and provides information to consider icons as the elements of language in educational signs. Our results have implications on how to localise software in Urdu, how to train digital literacy, how to create interfaces in right-to-left readers, and how effectively technologies are cross-cultural with the 230 million Urdu speakers around the globe.*

**Keywords:** *educational semiotics, visual morphemes, Urdu educational interfaces, cognitive icon processing, linguistic determinism, cross-cultural learning design, right-to-left educational technology*

### **Introduction**

The world of teaching has been transformed because of digital learning tools. Icons have become major features in the interface that enable the learners to interact with the information (Farhan et al., 2019). Icons in e-books, learning management systems as well as interactive courses do not just look good. They assist learners in moving around, demonstrating concepts, initiating actions, and managing the knowledge (Karagöz et al., 2023). The majority of the studies about the functionality of icons have been conducted in the Western context and little has been done to determine how other learners of different language and cultural background employ them.

The under-researched nature of the tools applied by the Urdu speakers is particularly evident. Urdu is an Indo Aryan language that is written in the right hand script that is altered Arabic script (Niazi, 2021). It is spoken by more than 230 million citizens mostly in Pakistan and India (Farooq, 2025).

Urdu possesses unique linguistic characteristics that might alter the manner in which the learners perceive icons. The culture-specific meanings, awkward word structures, and right-to-left writing can alter the comprehensibility of the visual cues by the Urdu speakers in Web-based learning (Khalid & Aslam, 2024).

This paper fulfills that gap by researching on icons as meaning-making units in Urdu learning aids. We propose that icons are morphs of languages, the smallest segments of a word that have a meaning. They are mixed with words in the interface to produce bigger ideas. By seeing icons in this sort of manner, we can get a chance to study the way Urdu speakers interpret them and how their languages inform their meaning.

One of the central concepts in our labor is linguistic determinism: the opinion that the language structure influences the way we think. We examine whether the features of Urdu alter the way the learners comprehend icons. This may create cultural differences and influence the effectiveness of technology and the teaching (Slobin, 2011).

### **Research Questions**

What are the roles of icons as the small units of meaning in Urdu learning resources, and what is their relationship to written text?

What are the mental impacts of icons in the comprehension of Urdu learners, their concentration, and interpretation of content?

What do Urdu learners think of icons compared to learners of other languages, and what are the cross-cultural patterns?

What is the extent to which the influences on processing and understanding of icons are made by Urdu word shapes, writing right to left, and meanings?

### **Significance of the Study**

The research has numerous theoretical and practical advantages. To start with, it is based on educational semiotics in demonstrating that icons may be regarded as small units of meaning like components of words. This concept in conjunction with word-analysis presents novel approaches to the study of mixed media teaching resources.

Second, the study addresses the excessively Western-centric nature of learning-tech literature by studying Urdu, a large non-Western language that has its own peculiarities. The fact that the Urdu speakers read icons informs us about how language and culture influence the manner in which people utilize interfaces that purport to be universal.

Third, the research on the influence of language on icon interpretation contributes to the study of cognitive linguistics and cross-cultural studies. It demonstrates that there are rules of language that affect the perception of visuals of real teaching tools, which satisfies the desire to go beyond the simple tests to the everyday technology.

Fourth, the findings can assist teachers, designers and policy makers enhance digital learning among the Urdu speakers. Understanding where to place icons, the way in which individuals across various cultural backgrounds read icons and how minds interpret it can be useful in developing interface designs that are not only respectful of culture but also translations.

Last but not least, Urdu is a language spoken in numerous states and communities, and it also plays a major role in hundreds of millions of schools. Being aware of how icons operate in Urdu learning tools will directly be useful in making education more equitable and more successful to the South Asian and global Urdu speakers.

## Literature Review

### Icons: Semiotic-Cognitive Components in the Educational Interfaces

An interface item of special type is educational icons. Their primary role is to facilitate learning through demonstrating pictures, assisting the users to move around, and aiding thoughts. This is unlike other computer icons which only enable people to use the system and learn the content simultaneously unlike educational computer icons which are applicable to learners of all ages and levels of skills (Ávila & Gudwin, 2009).

According to the dual coding theory, the combination of words and pictures is more effective in learning since the language and image components of the brain are all employed (Sadoski & Paivio, 2013). Good icons are used to memorize and locate information. However, the fact that humans perceive pictures identically is doubted - in that research indicates that culture and previous experience influence the perception of the icons (Luo, 2022).

According to the cognitive load theory, the smart icons facilitate learning through providing a simple navigation and a clear sense of order (Timileyin, 2024). This allows students to spend their mental resources on learning material. Poor or culturally incorrect icons create extra thinking by compelling students to learn to interpret unknown signs, which is detrimental to learning.

New work considers icons as being more than pictures. They are the resources that assist students to reflect on the areas of knowledge. According to Lemke (2005), there are multiple types of media used in science instruction, and pictures should not be viewed as mere decorations, but as the essential component in meaning construction. So icons are not mere pictures, they are active and they assist one to think.

### Linguistic Determinism and Visual Symbol Interpretation

According to the Sapir-Whorf hypothesis, and its moderate form known as linguistic relativism, the modes of thought, the ways we observe things and the ways we classify things can be influenced by the manner in which we use language (Fruchter, 2018). The extreme belief that all thought is controlled by language is mostly incorrect, however, numerous experiments indicate that the linguistic categories we employ influence our attention, memory and reasoning in some systematic ways. Studies of spatial language indicate that when languages encode space in different ways (i.e. by referring to a speaker-centered view versus fixed directions) the encoding of space modulates how speakers reason about space and store spatial information. Likewise, tense, aspect and evidence marked languages are more likely to influence time relationship or source of information emphasis on speech.

The studies on the direction of reading reveal that the flow of reading, i.e., left-to-right or right-to-left, predetermines the manner in which individuals think of the time flow (Altin, 2022). The movement of the left to right is associated with time as passed by English readers, and movement of the right to the left with Arabic readers. This reading direction is habitual and forms abstract mental maps and the direction of scripts holds influence over even the non-linguistic tasks. Insofar as language influences thought, it must be that there is a morphological, directional, and category-based linguistic influence on how the Urdu speakers process educational icons. Assuming that language influences cognition, then these language specific patterns must be reflected in the way learners attend attention, interpret, and recall icons (Yang et al., 2020).

### Icons as Semantic Units in the form of Morpheme

The traditional morphological theory describes a morpheme as the smallest meaningful unit that is a free word or an affix, which attaches to another word (Manova et al., 2020). Morphemes may

form new meanings by combining with one another, tend to bring predictable meaning in the combination, and may occur in predictable locations in a sentence.

Applying this concept to the visual cues, we would suggest that educational icons act like the morphemes. The icons have a clear meaning, are systematically compounds with texts and other icons and they are constrained in position like the morpheme. A help icon is more a prefix to evoke meaning (e.g., to assist in vocabulary) (e.g. help + vocabulary = vocabulary assistance). Navigation icons serve as grammatical signals which indicate form and not new sense (Thongyuan & Siriganjanavong, 2023).

There are a number of benefits that could be seen in seeing icons as morphemes. To begin with, it provides a systematic means of categorizing icons as per their meaning and their combination. Second, it is the only way to compare icons across languages by researching the effect of language structure on icon-text integration. Third, it connects icon research with existing linguistic theory, and theory is transferable and refined (Nielsen, Luetke, & Stryker, 2011).

Most importantly, the treatment of icons as morphemes demonstrates the fact that icons do not have a certain meaning. Their origin is systematic combinations with other factors and can change during their repeated exploitation in certain situations, which may differ between cultural-linguistic communities.

#### **Interpretation of Cross-cultural Icons in Education**

Inter-cultural studies of interface design have established that varying users have varying perceptions of the same icons based on their backgrounds. To illustrate, Chinese viewers will have different interpretations of the icon, as compared to American viewers due to cultural schemas, familiarity of symbols and common associations. Such differences influence the speed at which users navigate and also the ability of users to accomplish tasks (Yu et al., 2026).

Research in the learning situation has discovered that interfaces designed to fit a specific culture enhance learning as compared to interfaces designed in a general manner. Its progress can be partly attributed to the fact that adapted interfaces ease cognitive load as well as make users feel much more confident, which demonstrates that cultural adaptation should involve not only translation but also visual component redistribution. In the case of Urdu education interfaces, investigative findings indicate that a mere reflection of a left-to-right layout by a right-to-left layout usually performs poorly. The information organization and attention to other elements of a screen between the users of the Arabic language is not the same; thus, the right-to-left design requires a reconsideration instead of a mere reversal (Aziz, 2016). The research on the cross-cultural interface is mostly related to general computing, rather than to teaching apps. Educational icons have additional requirements: they need to transmit abstract ideas and help to build the knowledge and demonstrate interconnections. These requirements can enhance cultural misunderstanding (Bhat & Alyahya, 2023).

#### **Urdu Characteristics of Language Concerning the Icon Interpretation**

The peculiarities of Urdu can have an effect on the interpretation of icons. To begin with, Urdu has a slightly adapted Perso-Arabic script that is right-to-left, so the readers are accustomed to reading rightwards. This habit may influence their approach and management of the space in a screen. Second, Urdu is a morphologically dense language, and lots of derivational and inflectional operations, gender agreement, aspect-prominent verbs, and prolific compounding. This richness can predispose Urdu speakers to observe systematic meaning patterns, which could help combine icons with text in case the icons are perceived as morpheme-like units. Third, Urdu language has

cultural ideas such as religious words, kinship and indicators of social status that are not common in English. These culturally specific schemas not related to the original meanings of the designers may be understood as icons representing the social ties, power, or the abstract group. Fourth, the Urdu education environment is focused on respect to teachers, cooperation in learning, and memorizing. These values influence the types of icon functions that learners attach importance to as well as the use of interface affordances. Depending on the learner, icons of collaboration or authority can have a different pragmatic force on the learner as an Urdu speaker as compared to the Western learner (Ishfaq & Azim, 2025; Naz et al., 2014).

### **Research Gaps**

Even though they understand the importance of cultural diversity, there are still gaps. To begin with, although there is an icon research, there is a lack of research on the use of icons in the teaching contexts having specific pedagogical limitations. Second, the concepts of language determinism have not been explicitly transferred to the icons of digital learning, and it is not clear how the language can influence the process of icon processing. Third, the majority of Urdu technological research studies bilingual English-Urdu situations, and not pure Urdu learning. Fourth, the concept of icons as visual morpheme has not been built and experimented particularly in the field of education.

The research fills these gaps by integrating the experiments, comparative research, and the analysis of functions of icons as morpheme-like units in the Urdu education interfaces. It explores the understanding, focus and the manner in which morphemes icons act amongst the Urdu speakers.

### **Methodology**

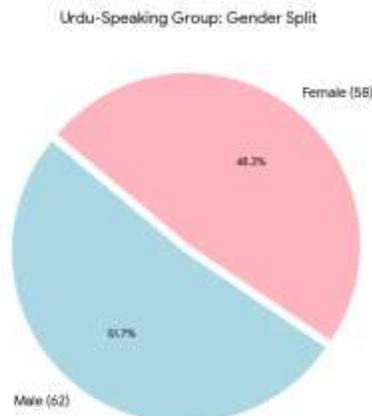
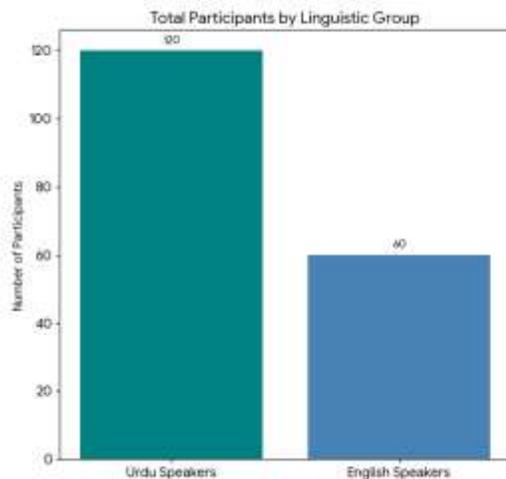
#### **Research Design Overview**

The research is based on a mixed-method approach that combines quantitative test, cross-cultural comparison, and qualitative analysis of the interface. The method combines the data of various sources and measures both cognitive performance (time to respond, accuracy, attention) and interpretative meaning (construction of meaning, cultural mediation, morphological functions).

#### **Participants**

The sample size of the study was 120 participants who spoke Urdu but only in the age range of 15-22 (mean 17.8, standard deviation 2.1), and the sample was recruited in secondary schools and universities in Islamabad, Pakistan. They were indigenous Urdu speakers whose main language of schooling was Urdu, but most of them could speak English on a functional level. The sample consisted of 58 females and 62 males of different socioeconomic status. The sample included a comparative group of 60 English-speaking participants aged 16-22 (average 18.1, SD 1.9) and of the United States and the United Kingdom to conduct a parallel study to compare them on a cross-cultural level.

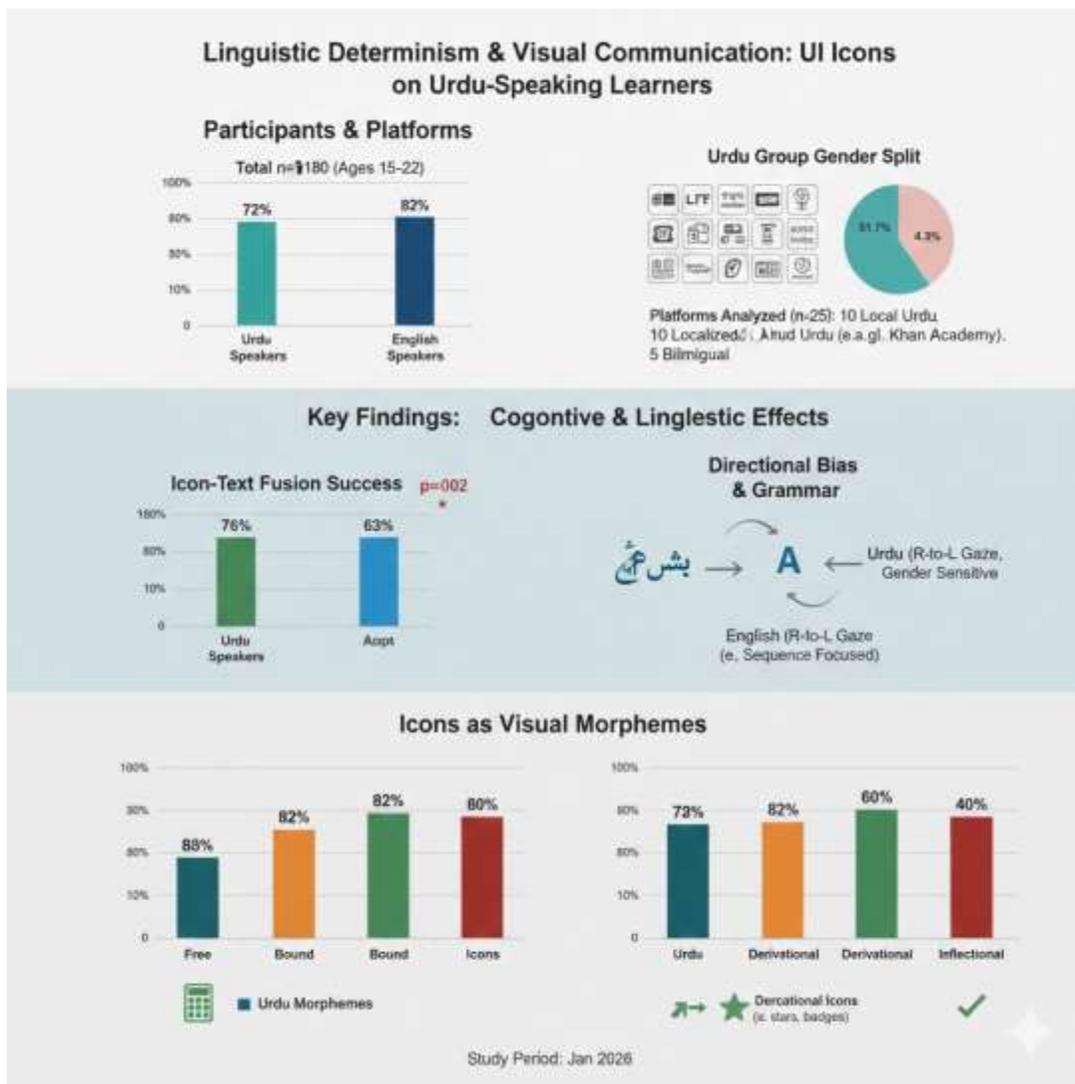
All the participants were with a minimum of two years of experience with digital learning devices and with normal or corrected vision. Informed consent was provided by them; informed consent was provided by parents on behalf of minors. The participants gave ethical consent to the research at the institutional review boards of the universities.



## Materials and Stimuli

### Educational Platform Analysis

We browsed 25 learning platforms and apps that were implemented in Urdu-speaking. We identified three categories namely, 10 local Urdu-only websites, 10 foreign websites, which have the Urdu version, such as Khan Academy Urdu, Duolingo, and 5 bilingual websites, which use both Urdu and English. We examined the icon types that they make, the locations of the icons, the correlation between the icons and the text and their adjustment to the culture.



### Experimental Stimuli

We developed standardized educational interface mockups featuring common icon types across multiple semantic categories:

**Representational icons:** depicting educational objects and concepts (book, calculator, globe, laboratory flask, geometric shapes)

**Operational icons:** indicating interface actions (play, pause, save, submit, download, help)

**Organizational icons:** marking structural relationships (next chapter, previous lesson, home, menu, hierarchical expansion)

**Modal icons:** signaling instructional states (quiz mode, practice mode, review mode, assessment)

Each icon appeared in multiple conditions: isolated, paired with Urdu text, paired with English text, positioned left of text, positioned right of text. This design enabled examining linguistic determinism effects, cross-cultural interpretation patterns, and positional preferences.

### **Experimental Procedures**

#### **Icon Comprehension Tasks**

The subjects were provided with the items to decode the icons that were presented on the educational resources. They viewed icons in isolation or with text and chosen the best meaning amongst a number of choices. We checked the frequency of their being correct and the speed at which they responded. The icons were both the actual educational sites and the new and artificial icon-text pairings to test their combination of meanings.

#### **Eye-Tracking Studies**

A group of 40 (including 20 Urdu speakers and 20 English speakers) individuals performed the tasks as we logged in the locations where they looked through a Tobii eye-tracker. They were looking at school screens and completing learning tasks. We followed the direction of their gaze, the duration of time their eyes remained in a position, and the movement of their eyes. We primarily analyzed how they attended to icons, the way they integrated text and icons, and whether they preferred particular locations on the screen or not.

#### **Think-Aloud Protocols**

Twenty Urdu speakers utilized real learning applications and verbally discussed what they thought. We transcribed and documented the discussions, and then sought how they clarified icons, how culture influenced them, and how they viewed icons as components that could be conjuncted with words.

#### **Comparison Tasks across Cultures**

The tasks on the icons were repeated by both the Urdu and the English so that we were able to compare them directly. The tasks involved abstract concepts, teamwork, challenge, authority, navigation icons, and new icon-text pairs to establish whether language background alters symbol reading by people.

#### **Data Analysis Procedures**

##### **Quantitative Analysis**

We made use of statistical models to examine frequency of people selecting icons correctly and the speed of people to respond to the models. The models took into account icon type, language of the text and location of an icon, but regarded each individual as an accidental variable. In the case of eye-tracking, we analysed the points of attention, the distribution of attention and the presence of directional bias. We adopted cluster testing to make comparisons between Urdu and English speakers. The analyses were performed using R 4.2.0 and the lme4, afex and eyetracking packages.

##### **Morphological-Semantic Analysis**

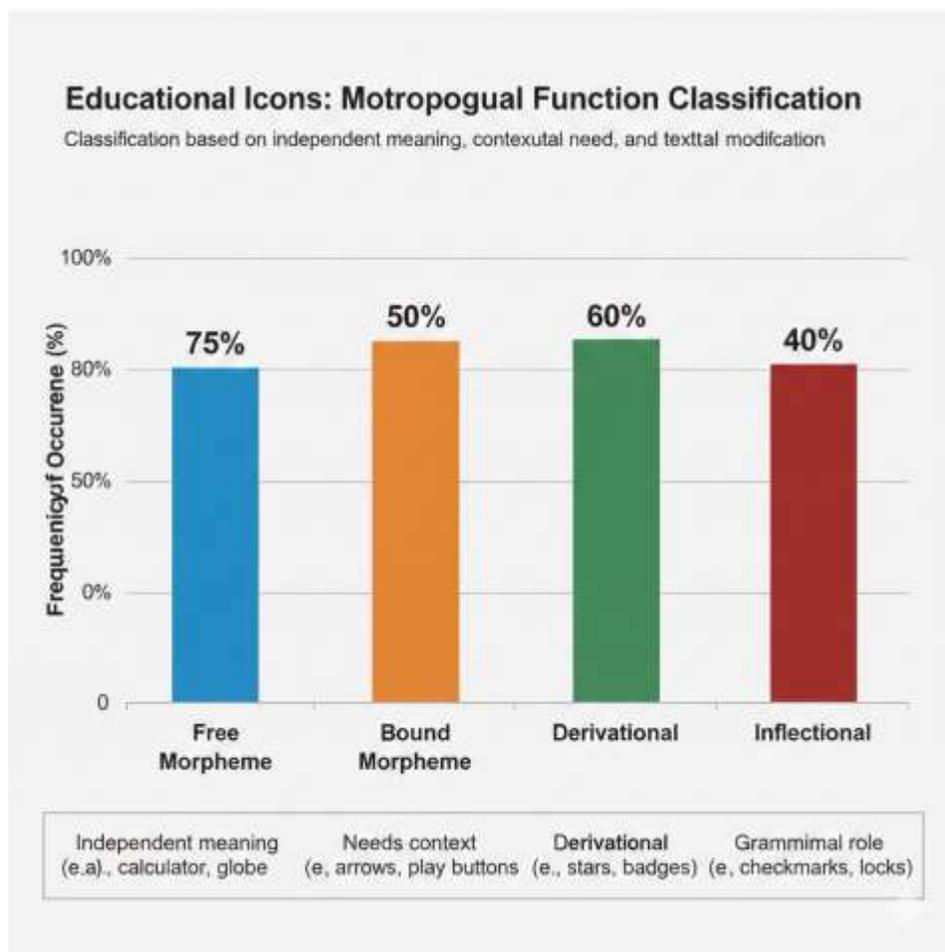
Icons were classified according to morphological function using distributional and semantic criteria adapted from linguistic morphology:

**Free morpheme icons:** carrying independent meaning, interpretable without accompanying text (e.g., calculator icon in mathematics applications)

**Bound morpheme icons:** requiring contextual integration for full interpretation (e.g., directional arrows whose meaning depends on associated content)

**Derivational icons:** modifying semantic content of associated text (e.g., difficulty level indicators, assessment type markers)

**Inflectional icons:** marking grammatical or functional categories without changing core content (e.g., completion status indicators, required/optional markers)



### Qualitative Content Analysis

The thematic coding of the transcripts of the think-aloud protocols was done based on: cultural interpretational frameworks mentioned by the participants, linguistic terms or morphologically conceptualized icons, indicators of systematic combinatorial interpretation, references to cross-cultural comparisons, and challenges or misunderstandings due to cultural difference between the design of the icons and the expectations of the user.

### Key Findings

#### Icons as Morpheme-Like Unit in Learning

The systematic morpheme-like properties were found through the analysis of icon use in 25 learning platforms. Icons were productive by mixing together with textual content in predictable ways to produce composite meanings. Here is an example, e.g. difficulty-level icons (one star, two stars, three stars) and lesson titles are derivational morphemes, which alter the level of semantic content, but leave the essence of lesson intact. This is similar to the derivational suffixes in Urdu to alter the meaning of the noun but is able to maintain a basic semantic reference. The educational icons had distributional limitations, which were similar to the positioning of the morphemes in the Urdu morphology. The operational icons (save, submit, help) were always in certain places within interface (not unlike the inflectional morphemes that have their specific places with respect to verb stems in Urdu). Directionally-related left-right systematic positioning of navigation icons was

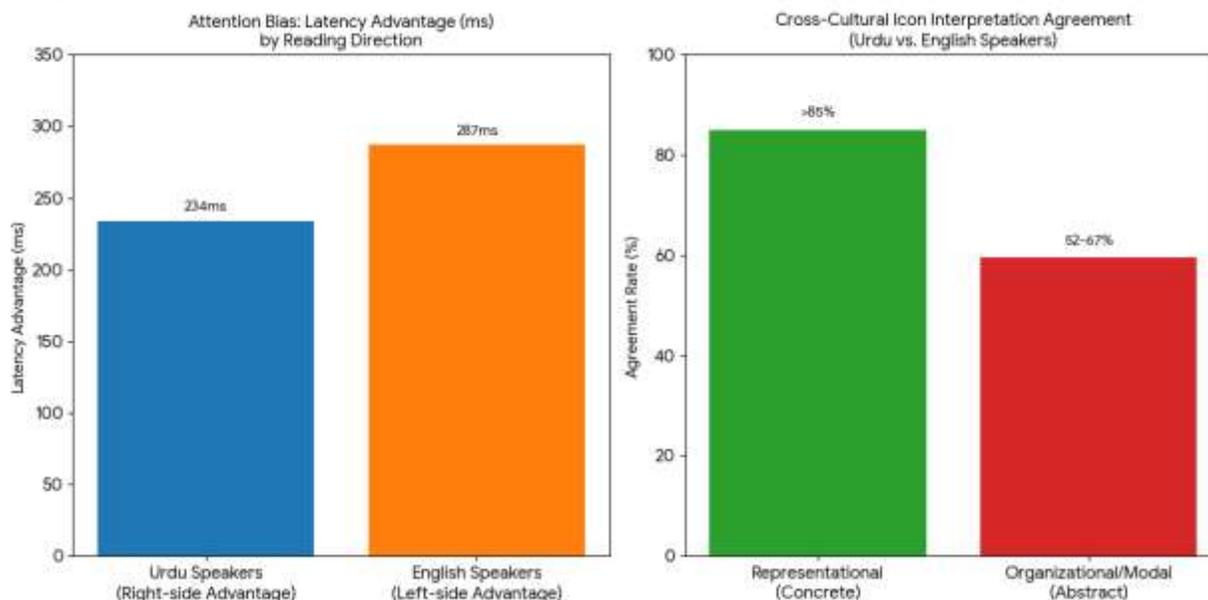
associated with directional meaning, and Urdu interfaces displayed reversed patterns compared with English interfaces by virtue of reading on the right.

Think-alouds made it clear that students perceive icons as creating parts of the meaning, including minute fragments that cling to the text. The participants often discussed icons using simple part terms, i.e. that icons are parts, which bonded to text material. One of the participants reported that the star icon was explained by the fact that there was an addition of the word difficult to the name of the lesson in order to make it different, however the lesson remained the lesson. Such an explanation reveals exactly how the meaning of an added part can be changed.

### Learning with Cognitive Effects of Icons

Eye-tracking experiments demonstrated that there were major cognitive impacts on icon design on attention distribution and understanding. The rightward attention bias was very strong in Urdu-speaking learners, who first focused on right-positioned items with a latency 234ms shorter than left-positioned items. This was the opposite of English speakers; leftward bias (287 ms advantage of left-positioned elements). Positioning of icons influenced the results of comprehension. Congruent positioning (right-side of the Urdu interfaces) also led to better comprehension accuracy by 12 percent. When positional conventions were found to be similar to reading direction, reading times of icon-supplemented educational material were found to be 18% shorter implying less cognitive load.

High cross-cultural interpretability was exhibited by representational icons of tangible educational objects (laboratory equipment, geometric shapes, mathematical symbols). Nevertheless, organizational and modal icons revealed high levels of interpretation divergence where the agreement rates decreased to 52-67%. This implies that abstract functional meanings are much dependent on conventional knowledge that might be influenced by linguistic-cultural backgrounds.

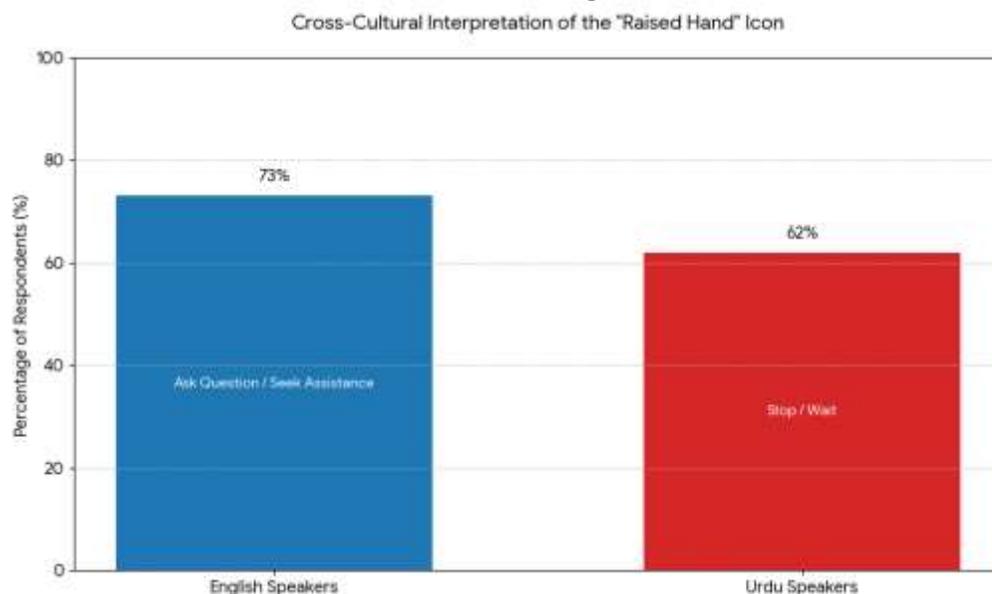


### Cross-Cultural Interpretation Patterns

In the majority of icons, someone can perceive them in various ways according to their culture. Culture particularly influenced icons that depicted social or learning circumstances such as having

a teacher in a charge, classmates collaborating or seeking permission. Urdu speakers observed an idol that implies power and has to be followed. The same icon was viewed by the English speakers as a friendly word that can be disregarded. This demonstrates the thinking of various cultures on authority in learning.

The differences were larger with icons which involve hands or gestures. A raised hand was interpreted by 73 percent of the English speakers as a query or assistance. In the case of Urdu speakers, 62 percent of the individuals interpreted the same gesture as command to stop or wait. English users interpreted a handshake as a method of working together, whereas most Urdu users viewed it as an act of agreement or deal and as a result of such a gesture the difference between them is very high and it is evident that the same gesture may be perceived in different manners. The Urdu learning websites had religious and cultural symbols compared to the Western websites. The usage of Islamic geometric patterns, Arabic writing, and green color represented identity and made Urdu speakers feel at home when they are learning. These signs were confusing to the non-Muslim users or the ones who had a more secular background.



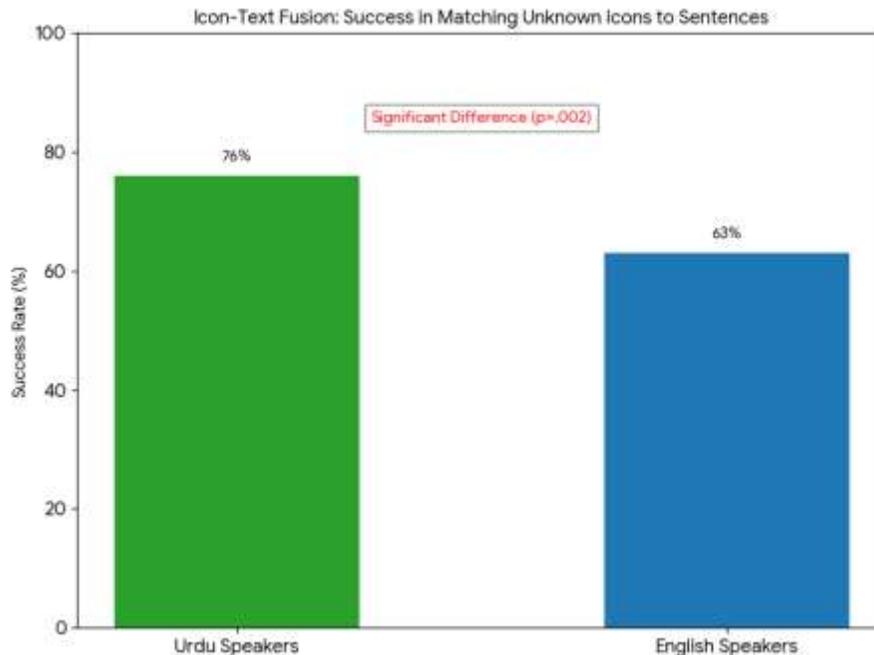
### Effects of Linguistic Determinism

Individuals who use the Urdu language look to the right when gazing at icons. The same is right bias that came as a result of reading Urdu right to left. It demonstrates that our reading direction may change the way we attend to non-language related tasks such as using a learning app.

In Urdu, there are various words with numerous components. Due to this fact, Urdu speakers perform better in incorporating new icons and words. They scored 76 percent on a test in which they were required to pair up an unknown icon with a sentence as compared to the English speakers who scored 63 percent. The difference ( $p=0.002$ ) demonstrates that those who learn using complex forms of words are more accustomed to the concept that icons might be parts that can be added to text.

In Urdu grammar, gender is a component of a sentence and, thus, Urdu speakers take gender specifics into more consideration when it comes to pictures. Research discovered that the Urdu

users tend to view more icons of differences between male and female students or roles compared to English users. This gender sensitivity is based on grammar rules of their native language. Urdu does not describe what is being done, but what has been done; not something that is in the past or ahead. Due to this reason, the Urdu speakers emphasize more on completion icons such as check marks or progress bars. They view learning stages as lessons completed or lessons underway. English speakers are more concerned with sequence of actions and look after such words as previous, next, or future.



### Right-to-Left Script Effects on Interface Organization

The right to left writing alters the way individuals design and utilize interfaces. There were three primary ways of organizing things on Urdu education sites that we visited.

**Mirror-reversed layouts:** These are the best sites that imitate the normal left-right layout but in inverted manner. They position the central menu on the right side, the flow of the text is right to left, and the icons are positioned to the right of labels. This is the same way reading is done by the users and easier to comprehend. **Hybrid layouts:** There are also sites which have some Western guidelines such as placing important stuff on top and centering but turn around on the left-right direction. This may confuse when there is a mixture of icons and text that is against the reading sequence. **Minimally-modified layouts:** Sites which simply translate their text to Urdu but do not change their layout do the least good. Users become disoriented, make errors (21 percent more than mirrored sites) and require a lot of time to complete tasks (34 percent longer).

Culture and language are also determinants of hierarchy in an organization. The Urdu sites tend to employ tree-like structures which make the parent-child relationships obvious, perhaps due to their grammar hierarchy marks. The English websites tend to employ flat structures in which items are grouped by category rather than hierarchical structure.

### **Icon Functions in Specific Educational Platforms**

Analysis of specific platforms revealed how icons serve distinct educational functions:

**Sabaq.pk (Urdu-primary platform):** Icons extensively marked lesson difficulty, prerequisite relationships, and assessment types. Icons functioned as inflectional markers indicating educational states (completed, in-progress, locked) and as derivational markers specifying lesson properties (interactive, video-based, text-based). Cultural adaptation included green color for progress indicators (positive association with Islamic identity) and star-based marking systems familiar from Pakistani educational contexts.

**Khan Academy Urdu:** Localization maintained Western icon designs but repositioned them for right-to-left flow. Users reported that while operational icons (play, pause) were readily interpretable, organizational icons (progress tracking, skill trees) required learning due to unfamiliar tree-metaphor organizational structures less common in Urdu educational contexts.

**Urdu e-books (various platforms):** Icons primarily served navigational functions (chapter selection, bookmarking, notes) with heavy use of text labels rather than icon-only designs. This reflected recognition that icon interpretation requires conventional knowledge potentially lacking in diverse user populations.

### **Discussion**

#### **Icons as Visual Morphemes: Theoretical Implications**

The concept of education icon as mini-shape-words can be used to understand the synchronous relationship between pictures and textual learning in the digital context. These simple shape-word properties can be found in icons: distinguishable units of meaning, combinable combinations, position principles, and forming new meanings. This picture-word concept is not an ordinary metaphor, but demonstrates that images and words unite in creating new meanings.

The concept further states that the meaning of an icon has no meaning to all people. It is based on the usage of it by people belonging to various language and culture groups. It is just like the change in the meaning of parts of words as time passes. The fact that the authority marks (such as leader icons as used by Urdu speakers) are perceived differently by the speakers of different languages (English and Urdu) indicates that the same image can achieve culture-specific practical uses by engaging in constant learning activities in other learning contexts.

The viewing of icon as shape-words will have a practical effect on studying educational technology. Researchers should not analyze icons individually and then examine their meaning in isolation, but examine how icons are combined with text and other elements of an interface to form complete meanings, as linguists study how words are combined.

#### **Educational Icon Processing Linguistic Determinism**

This paper demonstrates that there is unmistakable evidence that the language you use influences the way that you interpret icons as a part of learning. The processing of symbols will be different among Urdu speakers due to structure of their language- such as direction of reading, composition of words, categories of grammar and manner in which meaning is constructed.

The greatest influence is the direction of reading and its impact on people focusing on. Urdu readers read more towards right whereas English readers read more towards the left. It demonstrates that the visual attention of the learning screens is impacted by the habitual direction of reading. This proves that language has power to influence thinking outside the confines of language.

Combining icons with text more easily by the Urdu speakers demonstrates that language structures do not only influence what we are more attentive to but also how we interlace visual and textual meanings. Linguists who use languages with high word parts can learn to mix texts and pictures in learning tools by having the ability to merge individual units of meaning quickly.

The effects of language are different. Representational icons display minimal inter-cultural differences and that is, symbols resembling much what they signify (symbolic icons) indicate that language does not dominate the visual image. Most abstract icons, based on shared knowledge and not visual hints, are the most affected by language, which is consistent with the fact that language influences thinking the most where there is no visual hint.

### **Cross-Cultural Instructional Technology Design**

The implications of these findings to the makers of learning technology targeting different language groups have been made in reality. The concept of the icons being universal and language-free is flawed. The meanings of icons depend greatly on the language and the culture of people and this makes a evident gap in the meaning of an icon and influences the effectiveness of the learning process.

Doing more than merely translating words means that localizing effectively. It needs the redesign of the entire interface. Users who read right-to-left must have the layout reversed, icons must be laid out in accordance with their traditional patterns, and the structural patterns familiar in the West (flat lists, left-to-right progress) must conflict with patterns that are more appropriate in other societies (as-ordered lists, top-to-bottom).

Adaptation must also include icons that indicate concepts valued in non-western classrooms not represented in western products such as religious elements, family roles, authority structure, and collective learning values, which is equivalent to the individualistic ideas popular in western tools. However, the adaptation should be able to provide the balance between local fit and global consistency in order to allow the transfer of skills to the system. Educational technology must retain a sense of sameness to allow learning the digital generalities but still provide local flexibility, which makes things comprehensible and relevant.

### **Learning and Instructional Impact**

The design of icons influences the manner in which people concentrate and interpret. Where interface conventions disagree with the language-based expectations of users (icons in the wrong place, strange organisation, culturally ambiguous symbols etc.), an individual dedicates additional mental time to navigation rather than content learning, and this additional cognitive load raises unnecessarily.

Culturally appropriate interfaces provide learners with 12 percent comprehension and reading speed that is 18 percent higher. Such advantages are not only user-satisfying but enhance learning. The benefits may be compounded during longer sessions and on numerous platforms, which may be the reason why there is a difference in performance between Western and non-Western students who use the same technology.

Mentally-effort wise, the good icons are supposed to be like the supports which reduce, not increase, the load. They are expected to work with existing language knowledge of learners, align with reading direction and employ symbols that are compatible with cultural knowledge that they are working to add to the existing knowledge and not to contradict it.

### **Limitations and Future Research Prospects**

A number of limits imply future work. First, the participants were predominantly teenagers and young adults in the study. It may be the case that by studying younger children or older adults, the influence of age on icon interpretation and language influence may be revealed.

Second, the study participants were urbanized. A study of rural, less-educated, or low-literacy populations would demonstrate the validity of the results or whether the result is based on the level of education.

Third, the experiment involved still icons during a laboratory. A closer comparison of the animated icons, interfaces, and real-life learning situations would provide a more realistic result and determine whether the effects remain the same in a real-life application.

Fourth, additional language study (particularly of those that write right-to-left (Arabic, Persian, Hebrew) or have similar word-part structures (Turkish, Finnish)) would determine the precise language characteristics behind the findings.

Fifth, longitudinal research of the changes in the icon comprehension of learners would display the evidence of whether the repeated use of their icons decreases the cultural difference or the language impact continues to play out.

Lastly, an experiment comparing explicit icon-text combination rule instruction, where icons are treated as visual words, and explicit instruction would provide direct evidence that the shape-word system could be helpful.

### **Conclusion**

In this study, icons in the learning interfaces are analogous to the shape-words that mostly have meanings which are influenced by the language background of the user through language-influenced thinking. The icons are not a universal visual language but semi-symbols whose meaning is developed through common practices within groups of language.

To Urdu speakers, the processing, understanding, and integration of icons are influenced by right-left reading, numerous parts of words, and culture-specific meanings of words. These facts of languages influence the place of looking, understanding and learning speed.

The proposal of icons as shape-words that can be discovered in combination with text provides a useful inter-language theory. It points out that good icon design must learn to comprehend how visual and spoken words interact in each language, and not go into thinking icons are language-neutral.

In practice, the implication of these discoveries is that the localisation of educational technology should extend beyond text translation and reconstruct the entire interface using the results of a study on the interaction of language and cognition. The placement of icons, organisation of information and the symbolism should all be finely adjusted to each community.

In general, this research contributes to recent research on the diversity of languages in learning technology by presenting evidence that disproves the concept of universal design. As the practice of digital learning continues to gain popularity in every part of the world, understanding the cultural and language influence on interaction with technology is critical to equitable access and proper learning by all populations.

Considering the icons of learning as language-influenced visual shape-words provides a good theoretical foundation to multimodal teaching aids. Shape-word frameworks can be used to examine the interaction between picture, word, and interaction to form a rich meaning to different learners as learning technology continues to change.

Finally, this study demonstrates that effective learning technology should no longer be based on one-size-fits-all models but should view linguistic diversity as an asset, but not a problem. It transforms the special meaning of icons of Urdu speakers developed on the language structure into the asset to be respected and included in design.

The peculiar patterns in the system of interpretation of icons of Urdu speakers demonstrate that they are not the deficits to be cured but genuine cognitive-language systems that have to be respected and accommodated. Cultivating this diversity will benefit the learning technology of all and make digital learning equitable and accessible to all language groups of the world.

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