TUTORIAL BOOKING AND TRACKING APPLICATION INTERACTIVITY: A MULTIMODAL SOCIAL SEMIOTIC ANALYSIS FRAMEWORK

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Abstract

Electronic texts can be highly interactive. Forms of interactivity, such as hyperlinks, shortcuts, or tags, are not only signs that confer meaning on the e-page but also space for actions and changing textual situations. Here, e-page interactivity and textual interaction become two different realms, making a gap between text analysis and multimodal analysis. This case study aims to analyze the interactivity of the online tutorial booking and tracking application called 'ASP tutTrak' using a social semiotic multimodal framework for text and image analysis. The application is currently used in the Academic Success Center (ASC) of a tertiary level institution in the United Arab Emirates, and it was designed by the Information and Communication team of the same institution. The theoretical framework of the study presents a multimodal social semiotics analysis of sites, signs, and images of the 'ASP tutTrak' application through three metafunctions of communication (Halliday, 1978; Kress and Van Leeuwen, 2006). Since the application under consideration is in the academic domain, this study adapted Chou's (2003) framework for interaction types for learner-interface and learner-content. Analysis of five sample pages indicates that the interactive meaning potentials of the digital text, interface, and content are high, and the application is interactive.

Keywords: application, interactivity, interaction, multimodality, semiotics

Introduction

In one of his interviews, Van Leeuwen explained:

> The difference with the new technologies is that they have artificial intelligence built into them. Things that you had to know how to do before can now be outsourced to the machine. This was not reflected in our definition of "medium" in Multimodal Discourse … There we saw media as purely material, tools and materials. In modern media, the immaterial – knowledge – has become material. (Anderson et al., 2015, p. 105)

The above quote implies that machines can now handle functions that previously required human knowledge and skills. Tasks like data processing or decision-making can be delegated to Artificial intelligence (AI) systems. This is a shift in the understanding of media, particularly in how knowledge and information are represented and utilized.

Through digital platforms, users can write, forward, create, generate, animate, or present texts and give feedback by writing, rating, or sharing. To produce each action, the user needs to act upon the text: to interact. Thus, if interactivity reflects the active relationship between users and e-texts, then hypertextuality is a key mechanism enabling this interactivity. Hypertextuality refers to the structure of digital texts that allows users to navigate non-linearly through interconnected content via hyperlinks. It enhances interactivity by giving users control over their reading paths and often incorporates various media types for a richer experience.

The concept of 'interactivity' can be understood in threefold. It can be interpreted as the interaction between two or more people, the interaction between people and computers, and the interaction between people and networks, screens, software, or hardware. Different types of social interactions and human-computer interactivity often conceptualize 'interactivity' as an ordinal variable, where face-to-face communication represents the highest level and user-to-system interaction the lowest (Strommer-Galley, 2010). To move from the abstract concept of 'interactivity' to its effects, design, and operations, we first need to understand the two phenomena it equally refers to: interaction between users and the application interface, and interaction between users and the content provided within the application.

According to Halliday's *An Introduction to Functional Grammar*, language is a human communication system and medium for people to model and represent their world of experience, manifested by the element of 'process' in a clause. Kress (2010) also gave a similar interpretation of human communication and explained that "communication is focused on social (inter-)action in a social relation of me with others, as my action with or for someone else in a specific social environment, with specific relations of power" (p. 49). So, if the language and communication between humans is an *interactive process and action*, what is communication between humans and computers?

Carroll and Dahlstrom (2021) and Stromer-Galley (2010) explain that interactivity occurs as a 'product' when technological features allow humans to interact with a computer system or interface. This would mean producing a message, creating or opening a hyperlink, animating

pictures, annotating texts, filling up surveys, and making graphs, to name a few. Interactivity as a product, consequently, will also be the *affordance* of the medium, which will be activated through the user's clicks or touches to the screen, causing textual changes with every performed step. The *medium* refers to the digital platform or interface of the application that facilitates user interaction. In Adami's (2015) view, the way a museum's interactivity shapes what visitors can engage in reflects how a website's interactivity determines what users can accomplish on that site.

In a 'product' view of interactivity, the user deals with the digital platform: the site and the embedded signs to be acted upon for effects. In other words, the interactivity as a 'product' is the user's interaction with the computer interface and the electronic content. As Chen and Cheung (2022) mentions, "interactivity is defined as the affordance of the text with multimodality to be acted upon, realizing the full capacity of hypertextuality, and thus, meaning-making" (p. 20). As for educational applications, the meaning-making process is embedded in the affordance of interactivity to make the learners' learning process more manageable. This approach highlights the importance of understanding how different modes of interaction within educational applications contribute to constructing meaning for learners. To explain meaning-making as a social practice in the digital platform of academic application and through different modes, multimodal social semiotics is what this study will consider for the theoretical framework. Multimodal social semiotics helps to explore how learners navigate and interpret diverse modes of interaction, considering factors such as individual background, cultural context, and prior knowledge (Kessler, 2022; Ponzio & Deroo, 2023). This perspective acknowledges that meaning-making is not merely an individual cognitive process but a dynamic interplay of social interactions and contextual influences.

This understanding of meaning-making highlights the necessity for the specific elements that facilitate interaction within digital platforms to be examined. By focusing on the semiotic resources available in educational applications, insights will be uncovered regarding how these resources shape learners' experiences. Investigating the interactive features of the 'ASP tutTrak' application will provide insights into user engagement mechanisms and how social and contextual factors influence these interactions.

The research questions guiding this study are the following:

1. What are the interactive semiotic resources of the "ASP tutTrak" application in terms of user-interface and user-content interactions?
2. How do the interactive semiotic resources convey meaning to the user in the "ASP tutTrak" application?

Literature Review

Interactivity in digital educational applications has emerged as a critical factor in enhancing learner engagement and facilitating effective knowledge construction. Van Leeuwen (2005) emphasizes the transformative role of technology. He notes that advancements in artificial intelligence have shifted how knowledge and skills are represented, enabling machines to perform tasks previously reliant on human expertise. Several experts in the field share this

viewpoint and highlight the need to reconsider the concept of interactivity, which can be understood as the active relationship between users and digital texts, particularly through hypertextuality (Ni et al., 2023; Ponzio & Deroo, 2023; Wong, 2019). Hypertextuality is a foundational aspect of digital communication that significantly impacts how information is consumed, understood, and interacted with in educational and other contexts. (Strommer-Galley, 2004. Its non-linear structure empowers users to explore information in a way that suits their individual learning styles (El-Masry, 2024). Moreover, hypertextuality involves linking various pieces of information, whether they are articles, images, videos, or other multimedia elements. These links (hyperlinks) create a web of related content, making it easier for users to find relevant information quickly (Lam, 2014). As Almumen (2023) explains, the ability to interact with hypertextual content enhances user engagement, making the learning experience more dynamic and interactive. This combination of hypertextual navigation and interactive features fosters a more immersive and user-centered experience. Nikonorova (2022) notes that hypertextuality and interactivity enhance the meaning-making process by allowing users to make connections between different pieces of information. As users navigate through hyperlinks, they can see relationships and context that contribute to a deeper understanding of the subject matter.

Each interaction can be seen as a semiotic act where users interpret signs and symbols to navigate and engage with the content. When users interact with digital interfaces, they respond to the information presented and create new meanings through their actions. For example, clicking a hyperlink can lead to a new page that offers additional context, changing the user's understanding of the content, whether textual, visual, auditory, or gestural. Users interact with various modes simultaneously, such as reading a text while watching a video or listening to audio while navigating a webpage. Hence, interactivity empowers users by granting them agency in their learning and meaning-making processes (Kessler, 2022; Ponzio & Deroo, 2023).

While hypertextuality promotes a sense of exploration and discovery, interactivity promotes active engagement with digital content, including clicking links, filling out forms, and manipulating media. As Kessler (2022) explains, users choose how to navigate and interact with content, and with this, they bring their backgrounds, cultural contexts, and prior knowledge into the interpretation of signs.

This aligns with semiotic perspectives that highlight the role of culture in shaping how signs are understood (Kessler, 2022; Lomas, 2019). Different user groups may interpret the same sign differently based on their cultural contexts, making it essential for digital content designers to consider diverse user perspectives. As Wong (2019) notes, interactivity and semiotics together provide a robust framework for understanding how users engage with digital content and construct meaning. By analyzing the semiotic resources embedded in interactive environments, researchers and educators can gain insights into the complexities of user engagement, the processes of meaning-making, and the implications for designing effective digital learning experiences.

As many scholars have highlighted, technological advancements have revolutionized the ways knowledge is represented and accessed, necessitating a re-evaluation of traditional concepts of interactivity (Lawes, 2019; Ni et al., 2023; Wong, 2019). This evolution emphasizes the importance of multimodalities, which refers to the integration and interplay of multiple modes of

communication within digital environments, such as text, images, audio, and gestures (Kessler, 2022). In this context, semiotics plays a crucial role in understanding how these diverse modes function as signs that convey meaning (Lawes, 2019).

By integrating multimodalities and applying semiotic analysis, educators can better understand how diverse signs and modes of communication shape meaning-making processes. This ongoing evolution in digital education necessitates continual reassessment to ensure that educational tools effectively meet learners' needs.

Theoretical Framework

Derived from the structural linguistics of Saussure and Peirce's phenomenological pragmatics, semiotics significantly impact how we approach critical theories of primary media forms today (O'Neill, 2008). Social Semiotic Theory was developed by Kress and Van Leeuwen (2006) based on Halliday's (1978) idea of language as a semiotic system for meaning-making. This provides a starting point for examining other semiotic systems called *modes,* including images, audio, and video. Kress (2010) describes the mode as a socially and culturally shaped and shared semiotic system. According to Halliday (1978), it fulfills three metafunctions of human communication: ideational, which represents meaning about real-world events; interpersonal, which represents social relations of communicators; and textual, which is text forming complex semiotic unit for meaning-making. Mirroring the three metafunctions, Kress and Van Leeuwen (2006) developed a theoretical framework called "Visual Grammar". The *representational* meaning, which is revealed in the story of the image; the *compositional* meaning, which is shown in the layout of the image and the *interactive* meaning, which is the viewer's perceptions of the image. The theory has four related assumptions. As Wong (2019) explains (as cited in Fordjour, 2021), the first assumption is that meaning-making is multimodal, implying that it simultaneously occurs through several modes. Second, semiotic resources are shaped by the social context, which means the semiotic resource is informed by the culture where the actions occur. Third, signs are motivated by individual motives, which means people consciously draw an aimed meaning in a social context. Finally, the intentions of the sign-maker guide their semiotic choices, meaning individuals employ concealed motives in all semiotic resources to achieve specific goals. This study will use the metafunctions of both theories (Social Semiotic Theory and Multimodality Theory) to give detailed explanations and analysis of both textual and visual-image communications (Table 1). Visual, linguistic, and kinesthetic elements are crucial in how users interact with digital applications. Examining these elements provides a comprehensive analysis of how different modes contribute to meaning-making, highlighting the importance of a multimodal approach in understanding user interactions in digital environments. By prioritizing the interactions among visual, linguistic, and kinesthetic modes, the framework acknowledges that meaning is not merely derived from isolated elements but emerges from their collaborative functioning. This perspective explores how users navigate and construct meanings through interactions with various semiotic resources.

An essential aspect of this framework is its recognition of the role of cultural context in shaping the interpretation of meaning. By examining the cultural nuances that inform user experiences, the study highlights how diverse backgrounds can influence interface design and functionality perceptions. This cultural sensitivity enhances the analytical depth, allowing for a

more comprehensive understanding of how different user groups may engage with the application.

This analytical framework offers several strengths that enhance the depth and rigor of the study on the ASP tutTrak application. The multimodal perspective recognizes that meaning-making is not confined to one form of communication but emerges from the interplay of multiple modes. By examining how modes interact, the framework provides a richer understanding of how users engage with the application.

The framework also highlights how users navigate the application and engage with the content by exploring learner-interface and learner-content interactions. This focus on interactivity allows for an in-depth analysis of user behavior and preferences, revealing insights into how effectively the application meets user needs and facilitates learning. Understanding learner interactions can inform improvements in the application design, enhancing user experience and satisfaction. By categorizing interactions as learner-interface and learner-content, it also highlights the various ways users can navigate, manipulate, and respond to the application's features.

Halliday's ideational, interpersonal, and textual meta-functions provide a structured approach to analyzing communication. This organization helps identify the specific roles that different elements play in the meaning-making process. Therefore, by integrating theories of multimodality and social semiotics, this framework enriches the analytical depth of the study. It allows for the exploration of what is being communicated and how and why it is being communicated in specific ways. This depth enables a more nuanced understanding of user interactions and the implications for educational practices. Its strengths lie in its comprehensive, contextual, and dynamic approach to analyzing communication, ultimately enhancing the understanding of user interactions in digital educational environments.

Table 1. *Adapted Multimodal Social Semiotic Analysis framework of the 'ASP tutTrak' application.*

Dimensions ***Multimodality Theory***	**Ideational function Representational**	**Interpersonal Interactional function**		**Textual function Compositional**
		Types of Interaction		
		Learner-interface	**Learner-content**	
Visual				
Linguistic: *reading & writing*				
Kinesthetic				

Mode, as a socially and culturally shaped and shared semiotic system, is realized by its medium: ways and output of information that can be realized through text, screen, sound, and movement. Medium gives mode *materiality*, which means that different modes of communication (like text, images, sound, and movement) become tangible through their specific mediums. Materiality refers to the physical presence or form modes take, allowing users to

perceive and interact with them. Liu and Lin (2021) mention that "the materiality of speech is sound happening in a sequence in time which yields a certain physical sensation. On the contrary, the materiality of the image is a graphic substance that is simultaneously present in space" (p. 247).

The meaning-making affordances of image and text are different, and therefore, they interact synergistically in the construction of meaning in digital spaces (Blitz-Raith & Liu, 2017). As Liu and Lin (2021) explain, every semiotic system has a unique method of creating meaning, and when they coexist, they collaborate to generate inter-semiotic meanings. Hence, visual, linguistic, and kinesthetic modes are semiotic systems that co-occur while operating electronic spaces. They will be used as dimensions in the framework of this study (Table 1).

Website pages are visually complex digital spaces that construct meaning through visual, audio, gestural, spatial, and linguistic modes, thus making it a multimodal platform. Chou (2003) suggests four types of learner interactions and nine interactivity dimensions with their interactive functions in learning and analyzing web systems (Appendix A). Chou (2003) illustrates types of interactions through the following categories: learner-interface, learner-content, learner-instructor and learner-learner. These interaction types help to categorize relationships between participants, including system, interface, content, and learner. The present study aims to conduct a multimodal social semiotic analysis of an application that is only a tutorial booking and tracking domain and is not designed for educational purposes (teaching, assessments, educational materials, etc.). Therefore, it will use Chou's (2003) learner-interface and learner-content interaction types as its analytical framework and not consider the other two types. Learner-interface and learner-content interaction are represented in this framework through the lenses of the interactivity dimension. This framework will help analyze the interactivity of this application by taking into consideration its functionality with the interface (fixed-frame design, site map, keyword search, downloading, status tracking, and so on.) and content (links to other sites and educational materials, multimedia presentation, user guidance, individualized instruction, and so on).

Method

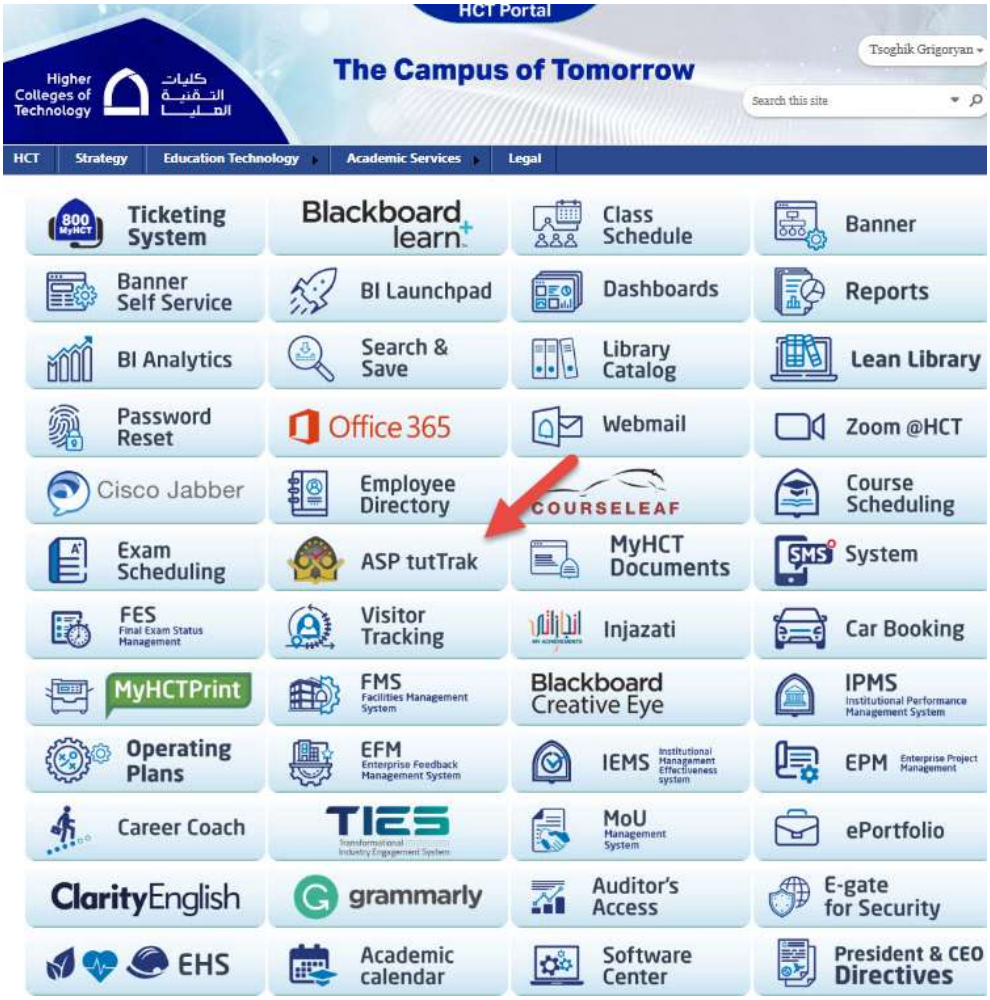
Following the theoretical framework discussed above, this research used a combination of the textual, visual, and interactive analysis of the Academic Success Program (ASP) tutorial tracking and booking app called "ASP tutTrak". The research used a qualitative approach and case study design. Case studies are selective and focus on specific aspects while giving a full account of the phenomenon under examination (Stake, 1995). In this study, ASP tutTrak application constitutes the case. This single application was chosen as the data source that offered practical analytical units and the possibility for examination from the perspective of interactivity.

The Tool: ASP tutTrak Application

ASP tutTrak is an academic tutorial booking and tracking application designed for students, faculty, and staff to book, administer, and refer students for tutorials. It can also be used to give post-tutorial feedback and track booked and completed tutorials in Academic Success

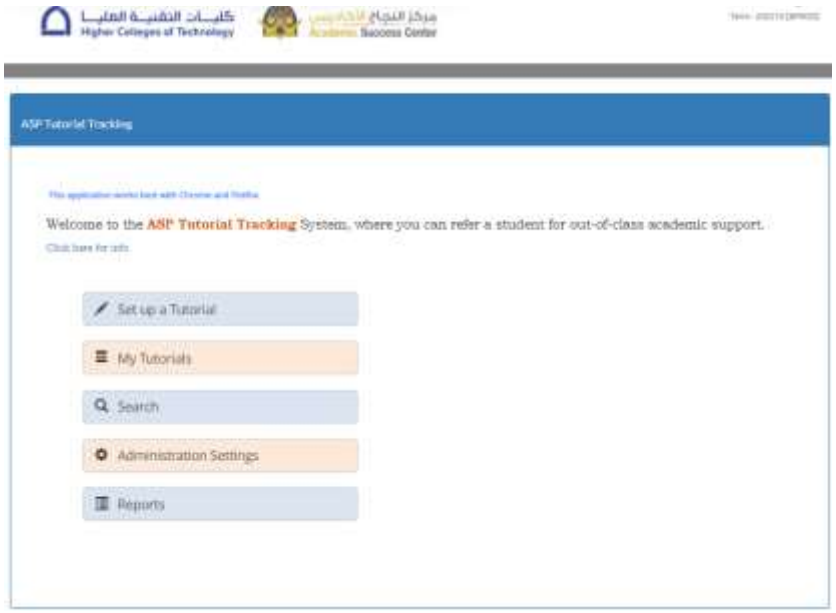
Program. The application is currently used in all Academic Success Centers (ASC) of a tertiary level institution across 16 men and women campuses system-wide that exist in all emirates of the country. The application was designed by the Information and Communication team of the same institution under the supervision of the program manager. The application is easily accessed through the institution's portal page called "application shortcuts" (Figure 1).

Figure 1. *Application shortcuts on the institutional portal page.*



As Figure 1 shows, the "application shortcuts" page includes shortcuts to all applications used in the institution, making it easy for users to locate and use the needed applications with a click. The ASP tutTrak application is indicated with a red arrow in Figure 1. The second step of the application use is straightforward, as the list of offered services is on the first page of the application (Figure 2).

Figure 2. *First/main page of ASP tutTrak, a Tutorial Tracking application.*



As shown in Figure 2, registered users, who are the students, instructors, and staff of the institution, can set up tutorials, track their booked and completed tutorials, search for available tutorials, and run different types of reports regarding their tutorials over a period of time.

Figure 3. *'ASP tutTrak' tutorial booking page*.

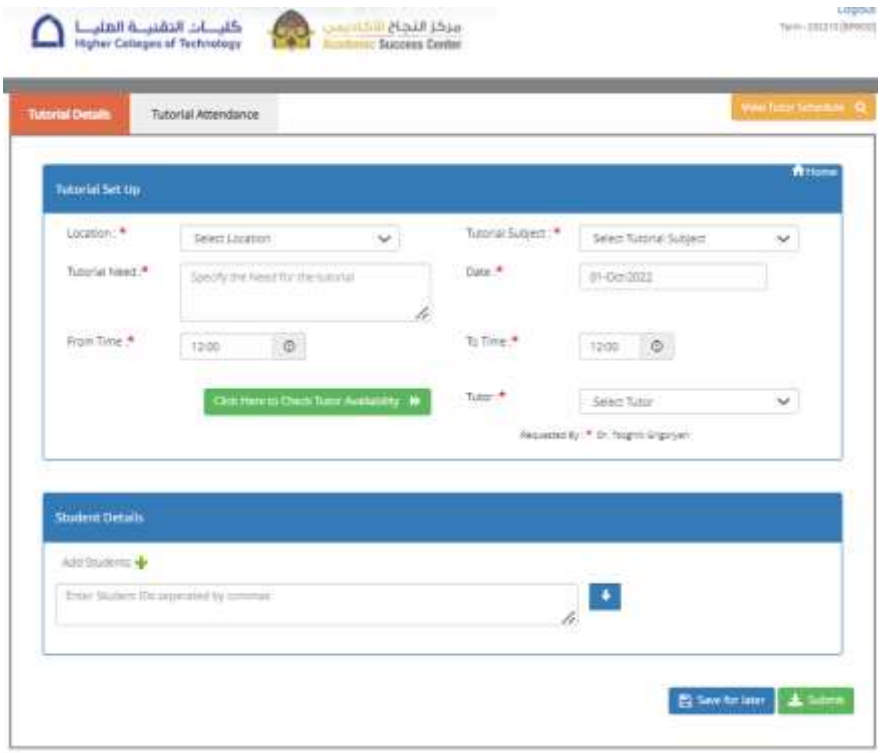
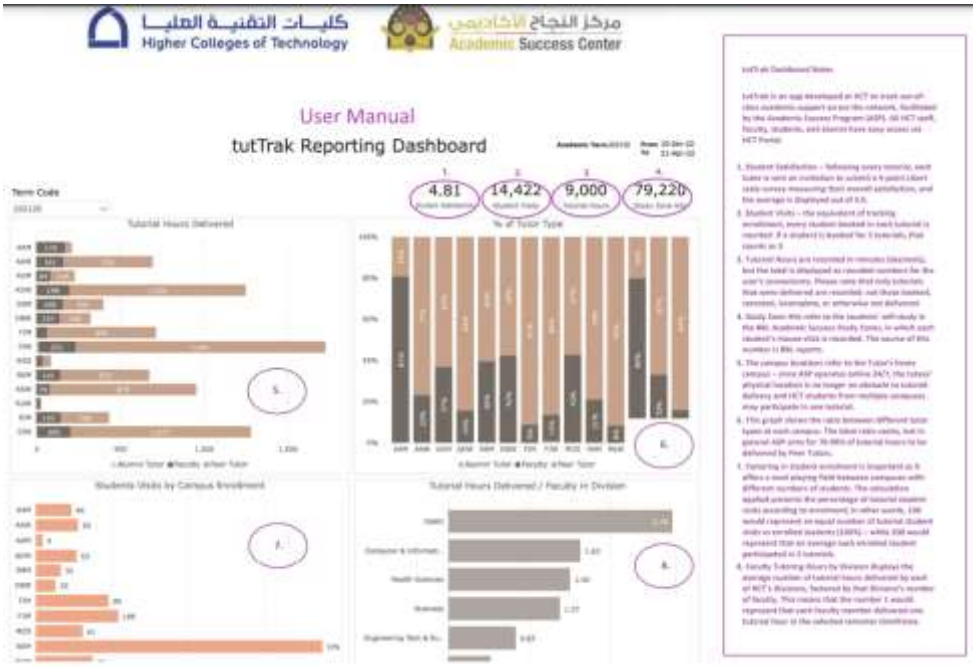


Figure 3 is the illustration of the tutorial booking page through which students book tutorials by filling in the boxes. As soon as the student completes the tutorial booking, the system sends an email with the details of the tutorial—date, time, location, tutorial code, tutor name, and tutorial need—to all parties involved: the tutor, tutee, ASC coordinator, and the ASC administrator. Every tutorial is generated with a unique code that is shared through the email. The code is used by the tutor and the tutee to access the tutorial room in a Blackboard Learn course named "Tutorial Zones". After the tutorial ends, the tutor completes the attendance through 'tutTrak' and writes comments about it for the requester, students, and system records. After the tutor completes the tutorial and submits the comments, the tutee receives an email about it where they can give feedback about the tutorial.

TutTrak also generates various reports about tutorial booking frequency, booked tutorial history, campus-based or across-campus comparative reports, infographics, and so on (Figure 4).

Figure 4. *ASP tutTrak reports.*



As Figure 4 illustrates, detailed reports can be run through ASP tutTrak, combined with text explanations and graphs/charts. All registered users can run these reports for their professional portfolios, research, progress checks, department meetings, and other reasons.

Figure 5. *Awareness-raising e-poster.*

The application also runs video advertisements and awareness-raising posters (Figure 5). They are sometimes in two languages, English and Arabic, to make the message understandable for students in their mother tongue. Women's campuses run the advertisement with a female student as a representative, and men's campuses run the same advertisement but with a male student as a representative.

The Participants

The participants, who are the users of the ASP tutTrak application, are the faculty, staff and students of the institution. This tertiary level institution has men and women campuses in all emirates and Academic Success Centers in each campus accordingly. In each campus the center is run by a coordinator and an administrator. All centers are supervised by the ASP program manager.

The participant students are 17-25-year-old Emirati male and female learners who enter the institution in pursuit of their undergraduate degree. The institution has Business, Engineering, Education, Computer Information Systems, Health Sciences, and other departments. Students can volunteer to book tutorials to improve their content knowledge and academic skills through the tutTrak application and become tutees. Tutors are also students

whose GPA is 3.0 and above and who volunteer to take a training course and become peer tutors (PT). Faculty can volunteer to tutor and become faculty tutors (FT). Both faculty and students can book and deliver tutorials. The staff is also registered in the 'tutTrak' and can run workshops and sessions or participate in tutorials. So, the tutTrak application is open for all institution members regardless of their role as a student, faculty, or staff.

Process

The data sources of this study include the above-discussed screenshots of the tutorial booking application pages and an image from a video clip, one of the center's awareness-raising advertisements. The discussed pages were purposefully selected, given the recurrent structure of the application pages. Departing from the assumption that application constitutes a communicative act, this paper will examine proposed pages for analyses, identifying the actors, their social role, their implied communicative actions, and the design underlying the application's composition and content (Michelson & Valencia, 2016). Then, this study will concentrate on rhetoric, design, ground, and interpreter suggested by Kress's theory. Next, a microanalysis of pages will be run to examine the conveyed discourse of overt and covert messages in the language, image, and layout of those pages. To summarize, since multimodal features of the application allow detailed analysis through more than one semiotic mode, this study will try to analyze the tutTrak application using multimodal social semiotic analysis. It will use multimodality theory, three metafunctions of communication theory, and look into types of interaction through Chou's (2003) learner to interface and learner to content interactions. Since this study has chosen five pages to look at (Figures 1, 2, 3, 4, and 5), four pages out of which being the institutional portal page and the ASP tutTrak application pages (Figures 1, 2, 3, and 4) and one image (Figure 5), this study will conceptualize both Halliday's (1978) and Kress and Van Leeuwen's (2006) models for better understanding of communication and image analysis (Table 1).

The selection of five pages for the analysis of the ASP tutTrak application was based on their representational significance and functional diversity within the context of the tutorial booking and tracking process. Each page was purposefully chosen to showcase key interactive elements that exemplify core features and user interactions of the application. The portal page serves as the entry point, highlighting the layout and navigation options available to users, while the main application page illustrates the initial user experience and the variety of services offered. The tutorial booking page is critical for understanding how users engage with the system to set up tutorials, providing insights into user-interface interaction dynamics. Additionally, the reports page reflects the application's capability to generate data-driven insights, underscoring the learner-content interaction dimension. Finally, the awareness-raising poster encapsulates the promotional strategies employed within the application, enhancing the understanding of how visual and textual elements work together to communicate key messages. Together, these pages represent a comprehensive overview of the application's functionality, interactivity, and user engagement strategies, making them ideal for a multimodal social semiotic analysis.

Data Analysis

Detailed analysis of all presented sample pages will be discussed under three metafunctions and exemplified in the conceptual framework (Table 2).

Table 2. *Populated Multimodal Social Semiotic Analysis framework of the ASP tutTrak application*.

Dimensions ***Multimodality Theory***	**Ideational function Representational**	**Interpersonal Interactional function**		**Textual function Compositional**
		Types of Interaction		
		Learner-interface	**Learner-content**	
Visual	Interactive signs (F. 1) Portal background image Linguistic – text: title, subtitles Signs: icon (magnifying glass, clock, house) Index (arrow, plus, underline) Symbol (asterisk) Poster image Graphs and bar charts	Fixed frame menu (F.1, F.2, F.3) *Choice* – drop down menu *Online problem diagnostics*-help boots *Monitoring info use* – reports, infographics	Links to related pages (F.1, F.2, F.3) App shortcut icons and within-page embedded links Adaptability through individualized spaces,ease of adding info.	*Information value*: icons, signs, indexes, shortcuts in the header andbanner that are important *Elements:* Image size, color contrast, sharpness of focus, place of the image on the space
Linguistic: *reading & writing*	Titles, subtitles, categories, sentences Icon, tag, symbol, and logo names and descriptions	*Writing for action*: fill in gaps, writing time, aim, and so on *Reading for instructions*: to fill in gaps, to choose and write the needed information	*Writing to search*: keywords to find the needed information *Reading for content*: information, steps, rules and regulations, infographics, and so on	*Salience*: elements in written format, slogans, pop-up titles, instructions, illumination, and so on
Kinesthetic	*Interactivity for 'action'*: Generate, monitor, hover over icons, write and fill in, submit, navigate, scroll, click, highlight, select, copy, paste, and so on.			

Ideational/Representational Function

Ideational/Representational metafunctions have to do with patterns of representation, in other words, the way experience is enclosed visually, which is carried out by narrative or conceptual structures (Stoian, 2015). Figures 1, 2, 3 and 4 are conceptual structures, because they represent users in terms of their class, structure, or meaning and Figure 5 is a narrative structure as it presents an unfolding action and forms an oblique line indicating directionality, called vector (Kress & Van Leeuwen, 2006).

The portal page, illustrated in Figure 1, presents 48 interactive signs equally distributed on one page. The top row 'Campus of Tomorrow' is the title and the 'HCT Portal' in blue above the title is the header of the page. On the left corner we see the logo of the institution in a bent triangle shape with the institution name in English and Arabic next to its sides. In the representational metafunction the triangle is symbolic as an abstract shape. The prevailing color is blue since it is the color of the institutional logo and portal background. The page title and background match by making the user observe the 'magic of tomorrow's campus' (page title) through futuristic vector images by using linguistic (portal title) and visual modes (portal background design). "The relation between the pictorial and textual is one of extension and complementary, where the content of the image adds further information to that of the text and vice versa" (Van Leeuwen, 2005, p. 230). The title and the logo on the banner are static and syntagmatic, thus they are not interactive. On the right, on top of each other, two paradigmatic and interactive drop-down boxes offer a choice for the user for various commands. The user can choose to click on the corresponding command to be redirected to the profile page or other user-related pages. The symbol on the right that resembles a magnifying glass is a lens that symbolizes the 'search' button. This kinesthetic mode is realized through the medium of typing and has the affordance of searching for the needed information. The upper part of the page is then separated with five paradigmatic windows on the menu bar, where three categories (HCT, Strategy, and Legal) are hyperlinked to other pages, and with a click, the user abandons the portal page and needs to click the 'back' arrow to go back to the page again. The other two bar windows (Education Technology and Academic Services) that show an arrow next to them have drop-down menus that offer a choice of spaces that the user can choose from and click to be redirected. The arrow next to the subcategory bar means there is a choice if you click on it.

The 48 application shortcuts, each with a small picture next to them, index the virtual place where the user can find all the needed information about the chosen field. They are all paradigmatic signs, meaning ideationally, the application shortcuts portal page is dense with interactive sites and signs in various forms. These forms are symbols, dynamic elements, and drop-down menus that require a lot of actions, such as clicking, choosing, typing, and searching to simply access a new text or space, which in itself is realized through labels, category bars, shortcuts, windows, and so on.

Page density is not high in Figures 2, 3, and 4. Figure 2 represents five window bars with a text and a symbol. The exciting part of this page is that even if users do not understand the text, they will understand the sign. For example, the pen in front of the first bar, 'Set up a tutorial,' hints to the user that if they click on that bar, they will have to write, fill in the gaps, type, and so on. The same can be said about the other bars: four lines that resemble a blank notepad stand for "My tutorials" and logically would mean records or history. The magnifying glass stands for 'search' of information. The signs, such as those like the notepad or magnifying glass, are icons because they are similar to what we already know about that object. Icons used on interactive pages make it easy for the user to orient in the space and make logical inferences about what each icon stands for. The third bar sign is "Settings," commonly used on all web pages. This sign is an index because it is recognizable, not because it resembles any real object, but because we understand the relationship between the image and the concept it stands for. The last bar shows a filled-up notebook sign for "Reports," which means the users can generate reports if they click on it. The explanatory text above the bars in Figure 2 makes it straightforward for the user that

the page is for operational use and has commands through bars that require action for effect. The blue text under the instruction sentence that says "Click here for info" is written in blue to invite attention and to indicate that the text is hyperlinked and paradigmatic, meaning it is interactive and can help the users find answers to their questions if needed. This means the signifiers (the signs on the sites) have their symbolic meanings as signified, commonly perceived and used in the tutorial application system by the users of that institutional society.

Unlike Figure 2, where users are only required to click on the bars and choose what they need, Figure 3 follows a more complicated kinesthetic mode of communication because it includes several spaces for the user not only to click but also to type in text, fill in information, and complete submissions to get the effect. While the Figure 2 page affordance is finding, locating, and choosing the needed information or page, the Figure 3 page affordance is completing the gaps with the required information to submit it for the final result: booking the tutorial. Figure 3 has eight red asterisks in front of the bars. These are symbols because we know the meaning of the image only because of convention; that it is something we have learned (Harrison, 2017). We have learned over practice that this sign of asterisk means essential and that without filling in the boxes marked with that sign, the user will not be able to complete the submission successfully. The small clock signs on the bars that say "From time" and "To time" are icons as they relate to what we already know or conceive about the object or person (Harrison, 2017). The clock here alerts the user to register the time of the start and the end of the tutorial.

The lower side of the page that is entitled "Student details" has two index signs: a green plus sign and a blue arrow. We understand that the plus sign means adding (information and details), and the arrow implies direction. The green plus index means the user can add student names in the box by clicking on it, and the blue arrow index showing down means the names, if added, will appear in that direction in the box.

Another difference of Figures 2, 3, and 4 from Figure 1 is that after clicking into the shortcut of the application, the university blue logo is accompanied by the ASP logo on all of its pages, signifying that the user is in the domain of the ASP tutorial booking system. The ASP logo is presented with two people/students happily raising hands for academic success with several stars, a red tick above, and an open book in front of them. Like the institutional logo, the ASP logo also has its name represented in English and Arabic. The logo image is analytical because the represented participants (two people hands up) are displayed in terms of a "part-whole" structure (Harrison, 2017). The "whole" is the carrier. In this case, it is the image of two people (who are most likely happy students) who succeeded academically because of taking tutorials. The stars, the tick, and the book are "parts" or attributes.

Figure 4 is a report that includes still images, graphs, and bar charts. These are analytical images in which the graphs are carriers, and their segments are *attributes*. They are also analytical processes that give the image technical and scientific resonance.

Unlike Figures 1, 2, 3, and 4, Figure 5 is a narrative image that allows the viewer to create a story about the represented participants because the image includes vectors of motion (Harrison, 2017). This is the main image on the site that, if clicked on, plays a video about two

students who help each other to consult ASP for tutorials and boost their academic success. Unless clicked on, it stands as an image. This image has several vectors (Kress 2010). One is the diagonal lines created by the students' hands holding the books. The vectors in this image create a strong interaction between the hands and the books, which are the represented participants. Smaller vectors are formed by the two books, which provide supplementary action elements. The image is combined with text, which creates an ideal/real system (Harrison, 2017). The image has *embedding*, which is one of the aspects of representation metafunctions (O'Neill, 2008). The image expresses multiple processes by showing out-of-focus books in the background. This is a conceptual structure or a symbolic method of books symbolizing education, learning, tutoring, and research embedded within this action process. The action of this image is motivating students to sign up for tutorials.

Interpersonal/Interactional Function

"The interpersonal metafunction enacts exchange, which includes expression of personalities and personal feelings on the one hand, and forms of interaction and social interplay with other participants in the communication situation on the other" (Anderson, et al., 2015, p. 4). The 48 application shortcuts on the portal page, in Figure 1, signal that the portal is syntagmatically connected with a range of recent networking options. The same can be said about Figures 2, 3, and 4 since all pages represent the complex dynamism of the banners, labels, icons, indexes, symbols, and hyperlinks to communicate a certain degree of interactivity of the application. The overwhelming blue color on the portal page and the combination of yellow and orange of the ASP tutTrak domain, modular layout, and font contribute to the shape identity values of the tutTrak application. Besides shaping the identity of the institution and the application, all of those mentioned above will shape and project the identity values of the users, who will be accustomed to and willing to use the embedded site features (Adami, 2015). If looking at pages in Figures 1, 2, 3, and 4 from the paradigmatic aspect, all hyperlinks, interactive icons, and sites enable the users to access texts or other spaces within the institutional domain. Interpersonally, this shapes a directionality towards the institution with recursiveness.

If one looks at the interpersonal and interactional functions of the application pages through the dimensions of interactivity between the *Learner and the interface*, it will become clear that the interface is entirely interactive. Pages give the learner a choice in all sections through drop-down menus, which come in a fixed-frame menu design. Pages have search engines, allowing learners to search for the needed information through keywords. The sites show responsiveness to learners through online problem diagnostics and hints: "Click here for more information" and "The application works best with Chrome and Firefox" (Figure 2). Learner-to-interface interaction is high through monitoring information used through the Reports page that the application generates (Figure 4). Learners can track their tutorial status, progress, and completion.

If one looks at the interpersonal and interactional functions of the application pages through the dimensions of interactivity between the *Learner and the content*, it becomes evident that learners have ample access to all educational sites through 48 shortcuts and within-page embedded links. The platform bears adaptability through individualized learning spaces, which are the tutor-tutee spaces for tutorials, emails, and feedback pages. Another dimension of

Learner-content interaction is the ease of adding information that learners contribute to learning materials by saving tutorial videos in the video bank for other tutee references.

The above explanation looked at how the application pages of the tutorial choosing and booking system interact with and engage with the user/learner through hyperlinks, signs, and other interactive features.

Figure 5 image engages the users through four aspects of the interpersonal metafunction: visual demand, intimate distance, frontal and medium vertical angles. The visual demand of this image is to create a direct address for students to book tutorials for higher academic achievement. The imperative sentence, "Book a tutorial and improve your learning experience," stands in the middle of the page as a central message to the user. The student's direct look and smile make the users feel optimistic about the call and motivate them to action. The student is dressed in national Emirati clothes, which suggests that producers wanted to add gender and national meaning to it —elements that are not included in the text. This advertisement is only run on female campuses and is directed to female students.

Since spatial distances are related to emotions and distance, Kress and Van Leeuwen explain that the relations between participants in images and the viewer are imaginary (2006). Hence, in the Figure 5 image, the smiling student is represented as a friend, classmate, or someone of the same nation, rank, level, or status as the learner users. This representation will create attraction and a sense of motivation.

The horizontal angle shows if the image producer and the viewer are involved with the represented participant. The frontal angle says: "What you see here is part of our world, something we are involved with" (Kress & Van Leeuwen, 2006, p. 143, as cited in Harrison, 2017, p. 54). In the case of this image, the vertical angle creates involvement of the presented character with the viewer, and the horizontal angle creates equality and an emotional connection to listen to her call.

Textual/Compositional Function

Textual and compositional functions relate to "how representations and communicative acts cohere into the kind of meaningful whole we call text" (Kress & Van Leeuwen, 2006, p. 181, as cited in El-Masry, 2024, p. 6). Meaning in this metafunction is built by three interrelated systems: *information value, salience,* and *framing*. In all pages in Figures 1, 2, 3, and 4, the important information is stored on the top part of the page as a header, which includes domain names, logos, and the vital sections the page needs the user to concentrate on and use the page for: for instance, tutorial details, tutorial attendance, and so on. The place for the user to work (kinesthetic mode), such as typing, filling in information, completing, or submitting, is in the front or middle of the screen. That is to say, the banner is salient and dynamic with blue, yellow, and orange colors against grey or white. Within pages, the banner has a salient position and is interactive. All pages can be scrolled vertically up and down and display multimodal text combining symbols and writing. Information on pages is not redundant, which makes the content coherent across sites. The aesthetics of interactivity is highly deployed at a syntagmatic level.

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Similarly, the paradigmatic plane shows the symmetry of power shaped towards the producer and users/learners. This means the users can provide feedback and access other institution pages quickly through the ASP tutTrak application, though they are only given access to institutionally approved pages. The relationship between sites and signs is cohesive with limited scope. The reason is that the tutTrak application does not allow third-party expansion, and interactive affordances are restrained within the institution and are only connected with tutorial booking and tracking.

The tutTrak application is equipped with the multimodal dimensional framework of textual, visual, and kinesthetic modalities. Because of its rule-oriented structure, it is highly interactive, cohesive, and user-friendly.

Figure 5 image uses all three information value types to transfer its rhetorical message to viewers. The text on the left represents the *given*, which is the program's call. In contrast, the woman on the right represents the students of the same nationality, gender, and occupation entitled to apply for the tutorial service. The image has a margin system with hands holding books as the basis of education and academic success. Most importantly, the text combined with the image serves the purpose and creates an ideal system (Harrison, 2017).

The representative size of the students in the foreground and the books in the background contribute to the rhetoric of the image that tutorials as extra help will be beneficial for academic achievement. The viewer here will be attracted to the action inherent in the central image as a hook.

Though the image does not have any framing with darker colors or lines, its dark font color on the background manages to cut it apart from the whiteness of the overall web page. The text is placed directly in front as a slogan on a white background to make it more visible and eye-striking for the reader. Though the image is not a photograph to convey emotions and results that are more realistic, the cartoon character is no less impressive with its emotional expressions and salient enough to capture attention.

Discussion

The purpose of this study was to investigate the interactivity of the ASP tutTrak application through the Multimodal Social Semiotics theory and answer the proposed research questions.

1. What are the interactive signs, sites, and images of the “ASP tutTrak” application in terms of user-interface and user-content interactions?

As the data analysis showed, interactive signs, sites, and images used in the application are various and multivariate. The application has embedded symbols, signs, indexes, and logos, sometimes accompanied by English and Arabic texts. All pages have interactive hyperlinks, tags, tracking and searching bars, and so on. In terms of user-interface, the data analysis showed that the application gives the learner ample choice for different operations within the page, such as site map, keyword search, data search, registration, submission, and so on. Learner-content

interaction, similarly, gives the learners non-sequential access of choice. This includes multimedia presentations, such as graphs and charts, that can be generated using different category choices. It also provides responsiveness to users and adaptability through hints, searches, and help bars. The application showed syntagmatic and paradigmatic features. Notably, the paradigmatic features were entirely enumerated, making the application stand as interactive.

The analysis revealed that the application employs various interactive signs, symbols, indexes, and logos, often accompanied by English and Arabic texts. This multilingual approach not only enhances accessibility but also reflects the cultural diversity of users, highlighting the importance of cultural context in interpreting semiotic resources (Nicholas & Oak, 2018; Ponzio & Deroo, 2023;). The richness of interactive hyperlinks, tags, and search functionalities allows users to navigate the application fluidly, underscoring the significance of hypertextuality in enhancing interactivity and user engagement (Almumen, 2023; Chen & Cheung, 2022). The interface design enables users to choose from various operational options, such as site maps and keyword searches that facilitate non-linear navigation catering to individual learning preferences (Kessler, 2022). This flexibility aligns with findings from recent literature that emphasize the necessity for educational applications to provide user-centric designs that empower learners (Fjørtoft, 2020; Ni et al., 2023; Nikonorova, 2022).

2. How do the signs, sites, and images communicate meaning to the user in the "ASP tutTrak" application?

Descriptive data analysis showed that the application's signs, sites, and images communicate meaning through three metafunctions detailed in the study framework. As a result, it became clear that sign-making in this application is varied when viewed through the richness of the actual semiotic world. The application is rich in text, signs, and images, which communicate meaning within the educational frame.

In addressing how signs, sites, and images communicate meaning within the 'ASP tutTrak' application, the analysis demonstrated that these semiotic elements operate within the three metafunctions detailed in the theoretical framework. Each element contributes to a complex web of meanings that reflect both the educational intent of the application and the interactive experience it offers. The findings indicate that the application is rich in multimodal resources that facilitate diverse forms of meaning-making, supporting the notion that learning is inherently a multimodal process (Ponzio & Deroo, 2023; Wong, 2019). For instance, the combination of visual elements (such as icons and graphs) with textual information creates a synergistic effect, allowing users to construct meaning in a way that a single mode could not achieve alone (Liu & Lin, 2021). This multimodal approach is crucial for effective learning in digital environments, as it caters to different learning styles and preferences, thereby enhancing overall educational experiences (Halliday, 1978; Kress, 2010; Ni et al., 2023).

Limitations

This study looked at selected pages of the application and did not expand to the process of tutorial taking, material sharing, and feedback-giving phases and pages. If analyzed, the results can help identify other emerging themes and communication. Moreover, this study

concentrated on application interactivity only. Future studies could focus on multimodal analysis of applications between technical interactivity and cognitive interactions of learners with content, software, or interface.

Conclusion

The study highlights the role of interactivity in the meaning-making process, emphasizing that the application not only transmits information but also facilitates engagement through active user participation. This dynamic interaction aligns with current theories that advocate for a more participatory approach to learning, where students actively co-construct knowledge through their interactions with digital texts (Kessler, 2022; Ponzio & Deroo, 2023; Strommer-Galley, 2010).

In conclusion, the ASP tutTrak application exemplifies how multimodal social semiotics can be effectively applied to analyze user interactions in digital educational contexts. The findings contribute to the understanding of the application and underscore the broader implications for designing educational technologies that recognize the complexities of communication in the digital age. Future research should continue to explore the interplay between technical interactivity and cognitive engagement, particularly how learners interact with content, software, and interfaces to construct meaning in varied educational contexts.

Appendix

The framework for interaction type, interactivity dimensions, and interactive functions in learning web systems (Chou, 2003, p. 271).

Types of interaction	*Dimensions of interactivity*	*Interactive functions in learning Web systems*
Learner–interface	• Choice	1. Fixed-frame (menu) design
	• Non-sequential access of choice	2. Site map 3. Keyword search
	• Responsiveness to users	4. Database search 5. Online problem diagnostics 6. Software downloading
	• Monitoring information use	7. Online registration 8. Grade status tracking 9. Assignment completion tracking
Learner–content	• Choice	10. Links to related educational sites
	• Non-sequential access of choice	11. Links to related learning materials
	• Responsiveness to users	12. Multimedia presentation (text, graphics, animation, audio etc) 13. On-line quiz for self-evaluation 14. Push media
	• Adaptability	15. Individualized learning database 16. Individualized instruction 17. Individualized test/quiz
	• Personal-choice helper	18. Frequently-asked-questions (FAQ) 19. On-line help on content 20. User guidance on system 21. Study guidance
	• Ease of adding information	22. Learner contributing to learning materials
	• Playfulness	23. Educational games 24. Jokes 25. Sweepstakes
Learner–instructor	• Facilitation of interpersonal communication	26. Email to instructors 27. Email to Web master
	• Ease of adding information	28. Bulletin board systems (BBSs) 29. Chatrooms 30. Online voting 31. Online survey 32. Comments on the sites, course, instructor, etc
Learner–learner	• Facilitation of interpersonal communication	33. Class roster 34. Email to other learners
	• Ease of adding information	35. Bulletin board systems (BBSs) 36. Chatrooms

The first type of interaction, *Learner-interface*, is represented as interactive through choice, non-sequential access of choice, responsiveness to users, and monitoring information use. The second type of interaction, *Learner-content*, is demonstrated through the same lenses of interactivity, but with four more dimensions added: adaptability, personal-choice helper, ease of adding information, and playfulness. The framework also suggests interactive functions in learning Web systems for each of the types of interaction and interactivity dimension.

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