

## USE WITHOUT TRAINING: A CASE STUDY OF EVIDENCE-BASED SOFTWARE DESIGN FOR INTUITIVE USE

Patrick Lehane

*Information Services Division  
University of Southern Queensland  
Australia*

**Abstract:** *This paper reviews intuitive software design and outlines the development of an instrument for analysts to evaluate the intuitiveness of software design. Current intuition research outlines three requirements for intuitive use: (a) existing experiential domain knowledge and skills, (b) an unexplainable perception that a novel situation is contextually familiar, and (c) successful application of users' previously acquired experiential knowledge and skills. A case study illustrates how these requirements can be specified, implemented, and evaluated. Questions to evaluate the characteristics of intuitive design and use resulted in an intuitive use evaluation of 3.2 on a scale of 0–4, indicating a perception of intuitive use. Subsequent factor analysis exposed three factors describing intuitive use: (a) Familiar User Expectations, (b) Confident Interactions, and (c) Leverage of Prior Learning. These factors map one-on-one to the requirements for intuitive use: providing an early confirmation of the proposed structure for analysis of intuitive software design and use.*

**Keywords:** *intuition, intuitive design, interaction design, usability, affordances, user experience, system analysis.*



## BACKGROUND

In this paper, I discuss the use of current research findings on intuition in an action research project involving software design and development. The criteria for intuition were used to develop a short survey for analysts to assess the degree of intuitiveness of a system design. The survey results can be included in stakeholder reports. The case study in this paper was the development of a course-level student evaluation (CLSE) survey system to be used by all divisions at a regional Australian university. Such a system used across the organization is termed an enterprise system. In this case, the enterprise system requires a manager to commission and manage the system on an ongoing basis and a cohort of academic staff users who use the system to promulgate content for the secondary cohort of student users. Regional universities in Australia have their principal campuses located outside the metropolitan areas of the states' capital cities.

The enterprise system used to deliver the CLSE has functionality that facilitates student feedback to university academic staff on the courses they run. The system's functionality also provides a feedback loop for academic staff to give feedback to the students on any comments made during the survey.

The software design brief from the university's senior management included the requirement that the software must allow users to complete the required tasks without formal training, a requirement more commonly specified as intuitive use. In this paper, I discuss the tasks required for a CLSE that would be employed by the academic staff. The system brief specified a CLSE that could be accessed by students on devices ranging from a desktop PC to an iPad, a survey management system for academic staff that could be used on similar devices, and a survey design and life-cycle management system for the survey system manager. Rather than build parallel systems for specific platforms, a responsive design system approach was adopted.

The challenge was to define intuitive use of the screen artifacts of a natural user interface for a responsive system. In the following chapter, I discuss the elements of intuitive use and current research on intuitive use. I then focus the discussion on how those tenets were applied to the design of an enterprise system used by academic staff who predominately operate desktop computers or laptops with keyboard and mouse in their offices. In this context, the visibility of interaction options is a paramount requirement for useful and consistent operations. Thus, a responsive design facilitated natural user interface operations with a touch screen. However, the commands to control the shaping of the data and progression through the business processes are menu driven.

Consequently, integral to determining the parameters for intuitive use was the need to specify the requirements for intuitive design and provide an instrument to evaluate whether or not intuitive use had actually occurred. This research paper presents a case study on intuitive design for intuitive use and the development of an evaluation method to determine whether intuitive interactions occurred.

## THE USER INTERFACE

The typical consumer user interface nowadays is commonly called the graphic user interface (GUI). It replaced the black-screen command-line interface of the mid-to-late 20th century. Shneiderman (1983) brought attention to the interaction requirement of the GUI: The graphic

elements were not autonomous and required an operator. Shneiderman coined the term “direct manipulation” to describe this operational requirement:

The central ideas [of direct manipulation] seemed to be visibility of the object of interest; rapid, reversible, incremental actions; and replacement of complex command language syntax by direct manipulation of the object of interest—hence the term “direct manipulation.” (Shneiderman, 1983, p. 57)

Because of this need for direct manipulation of GUI screen artifacts, good usability became a primary interaction requirement. Employing a direct manipulation interface (DMI) in screen design assists in focusing the design on this important aspect. It focuses the design on the interaction required for direct manipulation of the screen artifacts. Thus, the user interface is both a GUI and a DMI. The GUI facet is the vehicle to present to the user the screen artifact affordances, that is, their visual appearance and location. The DMI facet provides the underlying means to operate the commands and functionality of the software (e.g., a keyboard, mouse, touch pad).

Research into intuitive design and interaction is directed by both the visual aspects of the GUI design and the operational characteristics of the DMI design. The mental effort expended in working memory to use a computer is termed the cognitive load. The cognitive load comprises three elements (Sweller, Ayers, & Kalyuga, 2011). The intrinsic cognitive load is the effort associated with the use of specific screens for a specific domain. The extraneous cognitive load is the effort to interact with the screens and associated domain information. The germane cognitive load is the effort to assimilate screen use, domain knowledge and information into long-term memory.

The design of natural user interfaces (NUI) extends the range the interface interactions to include finger wipes, flicks, hand gestures, and body movement. The principle of GUI design facilitates remembering actions, promoting what actions are possible, and how to implement them. Visibility is a fundamental principle of GUI design, and menus make all possible actions discoverable. However, finger wipes, flicks, hand gestures, and body movement are not necessarily uniform between users, cultures, or nationalities (Buxton, 2010; Norman, 2010).

To learn and apply these NUI interactions to a menu driven touch screen was a tacit learning experience that was avoided when developing this system. To do otherwise would be to introduce additional cognitive load (Buxton, 2010; Norman, 2010) on a required but not frequently used system where data quality is the prime concern. As a result, consideration was given to only the basic NUI requirements for this responsive GUI menu-driven responsive design system.

The design brief from the university’s senior management contained the human-systems interaction requirement that the software to complete the required tasks should require no formal training. To use software without training implies that a person—any user—must have acquired some use-related knowledge prior to his/her initial use of that software: That is, the user must be able to intuit how to use the software (Sweller et. al., 2011). Research into intuitive design and a user’s cognitive load provide the keys to understanding and meeting this requirement.

Another key consideration of use design often given token development time for nonenterprise systems, such as commercial Web sites and smart phone apps, is support of the active user (Carroll & Rosson, 1987). This class of system rarely has help resources embedded; rather, users often post their learning experiences on the Internet. Useful and contextually aligned help resources can aid users in acquiring the information necessary for informed learning and skill

development because humans learn from other humans (Rasmussen, 1994; Sweller et al., 2011; Vygotsky, 1978). Humans frequently demonstrate their ability to boot strap, meaning employ self-determined incremental learning, to advance themselves to a required level of knowledge. This ability to apply the acquired depth and breadth of knowledge is a measure of a person's immersion in the domain praxis of a pertinent community of practice (CoP).

Help resources to assist with learning should be designed in line with the best practices of adult learning (Bandura, 1978, 1986, 1997, 2001; Knowles, 1984; Rogers, 2002) and instructional design principles of cognitive load theory (Sweller et al., 2011). When an individual experiences gaps in his/her experiential knowledge and skills that make intuitive use impossible, his/her use of help resources should scaffold his/her learning so that the acquisition of the required knowledge and skills is a positive self-development experience. For example, an experience where video and/or text format help resources instruct and guide the user through a series of learning sequences facilitates the accretion of contextual knowledge and skill. In this way, the help resources impart knowledge and enhance skill by guiding interactive learning experiences that also build self-confidence.

Blackler and Popovic (2015) reviewed the findings of researchers from four continents over the last decade and a half and summarized intuitive interaction research findings and methodologies. These concepts and other current research into intuition and intuitive use were applied in this case study to the selection process for the screen artifacts, their layout, and the visual presentation of information on the screen.

The screens were designed to meet the research specifications for intuitive use and to guide the academic staff through the step-by-step process whereby they edit and monitor a survey throughout its life cycle. The series of screens were designed specifically to scaffold users through the CLSE process without training on how to undertake a CLSE and the university's process for this survey without having seen the CLSE software previously. The objective was to present familiar objects in familiar contexts in a controlled sequence that facilitated the CLSE process with minimum cognitive load. These precepts embody current research into intuition, intuitive design, and cognitive load theory.

The principles applied to the design of the staff screens also were applied to the screens delivering the survey to the students, the survey design, and the development screens used by the system administrator. However, discussion on these latter screens is beyond the scope for this paper.

In the following sections, I present the theoretical rationale used to establish the intuitive design criteria and resultant intuitive use analysis methodology. The rationale I propose reviews HCI design criteria, maps them across intuition criteria, considers how they influence the cognitive load, and then develops of the question set to meet the previously discussed criteria to determine successful intuitive design and intuitive use.

## **INTUITIVE INTERACTION WITH USER INTERFACES**

Intuition is defined as reusing pre-existing experiential and formal knowledge in a novel situation. Preliminary research evidence indicates that, in a novel situation, intuition is a two-stage process based on past experience and experiential knowledge (Blackler & Hurtienne, 2007; Blackler, Popovich, & Mahar, 2009; O'Brien, Rogers, & Fisk, 2010). The first stage involves recognizing a conceptually similar contextual situation previously experienced (Nardi, 1996;

Preece, Rogers, & Sharp, 2007). Blackler et al.'s (2009, p. 1) definition of intuition summarizes the consensus on the essential elements of intuition: "Intuition is a type of cognitive processing that utilizes knowledge gained through prior experience. It is a process that is often fast and is nonconscious, or at least not recallable or verbalizable."

The second stage allows the individual to use the previously acquired skills and knowledge to undertake and successfully complete purposeful actions in the novel situation (Bødker, 1991; Checkland, 1999; Suchman, 1987). Intuitive use of software is the leverage of prior knowledge to reproduce familiar interactions with feasibly familiar objects in a novel context to achieve the anticipated outcomes. The intuitive process attempts to integrate already acquired skills and knowledge with the unfamiliar context by executing the interactions implied by the affordances of the screen objects (Gibson, 1977; Kaptelinin, 2014; Norman, 1998). When the intended intuitive interaction sequence produces the anticipated outcome, the intuitive assessment of the use possibilities is confirmed. Thus, intuition leverages prior knowledge to produce interactions with feasibly familiar objects in a novel context that achieves the anticipated predetermined outcomes.

When the intuitive interaction sequence produces the anticipated outcome, the intuitive assessment of the use possibilities is confirmed. This condition satisfies the requirements of Norman's (1998) "Gulfs of Execution and Evaluation" for successful operation of screen artifacts. Activity theory has a three-level abstraction hierarchy that contextually describes this series of events (Bødker, 1991; Nardi, 1996), and each level of the hierarchy has an associated cognitive load (Blackler, 2006; Embrey, 2015; Rasmussen, 1994; Suchman, 1987). The three levels and associated cognitive loads are

- Activity: A long-term formulation requiring controlled conscious processing of plans for actions or chains of actions that may impose a heavy cognitive load,
- Action: Knowledge application involving controlled conscious processing or rule application requiring intuitive processing with possibly some conscious level of involvement that may impose a moderate or light cognitive load,
- Operation: A scripted and skilled automatic behavior (operationalized action) at a nonconscious level of involvement that may impose a light or negligible cognitive load.

## Intuitive Design

Intuitive design is the craft of identifying and implementing familiar screen artifacts and screen layouts in new screen design. Intuitive interaction results from the recognition and successful use of familiar screen artifacts and screen layouts that look and work the way suggested by the familiar artifact affordances. When this goal is not achievable, the design compensates for lack of intuition with well-crafted contextually relevant texts to support self-directed learning experiences.

In their research into models for intuitive design, O'Brien et al. (2010) discussed Blackler's (2006) three principles for intuitive design.

1. Use familiar features from the same domain. Use familiar symbols and/or words, put them in familiar or expected positions, and make the functions comparable with functions users have seen before in similar products that perform the same function. Principle 1 is the simplest level of applying intuitive use.
2. Transfer familiar things from other domains. Make it obvious what less well-known functions will do by using familiar things as metaphors to demonstrate their function.

Principle 2 requires the use of metaphor to transform something completely new into something familiar by relating it to already existing knowledge.

3. Redundancy and constancy: Increase consistency so that the function, location, and appearance of features are consistent among various parts of the design and throughout each part. Principle 3 facilitates users applying the same knowledge and metaphors across all parts of the interface.

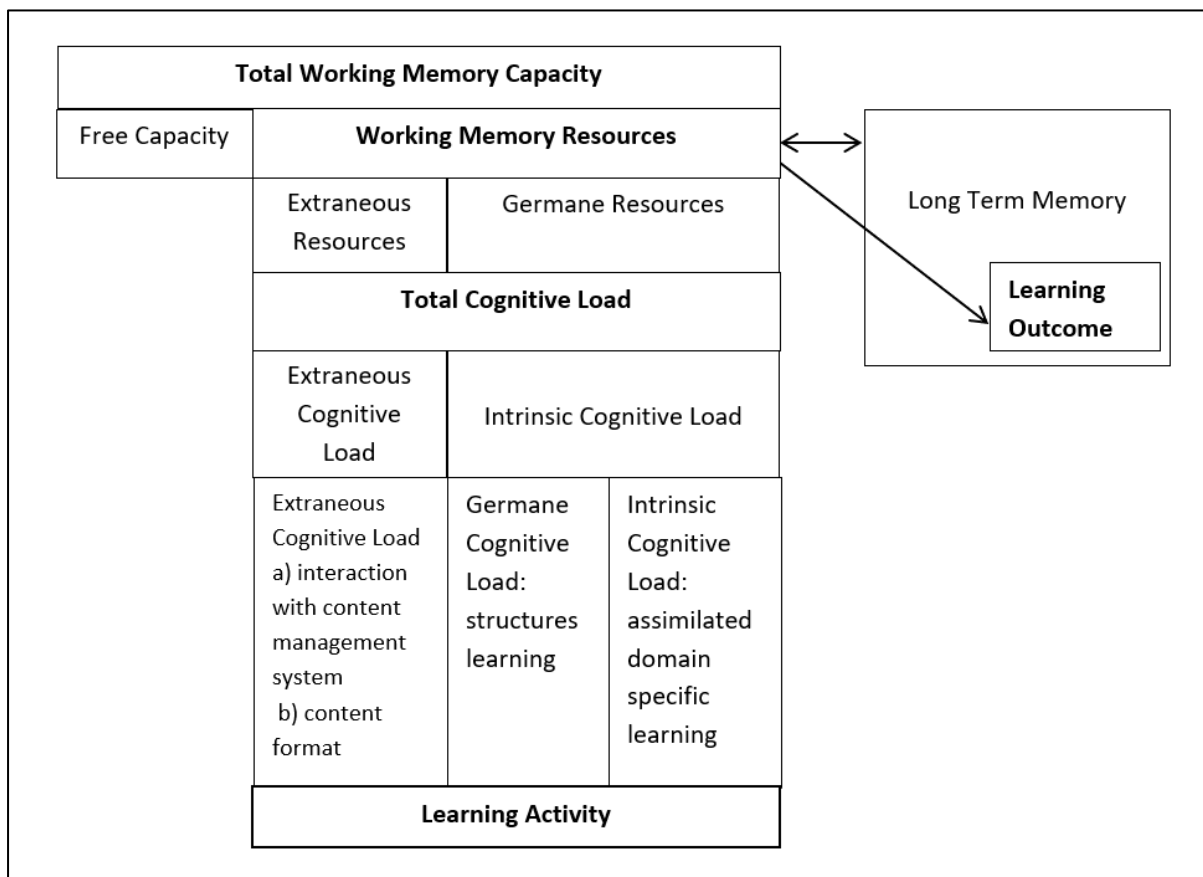
From a human–computer interaction (HCI) perspective, Blackler’s (2006) principles of intuitive design echo the best practices for interaction design. Elements of the design principles of Shneiderman and Plaisant (2010), Nielsen (1993), and Norman (2004) align with Blackler’s (2006) principles, as shown in Table 1. Consequently, it is possible for the user to apply intuitive design without being conscious of it.

When screen design employs familiar screen layouts, artifacts, and terminology, the user’s cognitive load is reduced because the actions are readily implemented as operations. Operations, by definition, are skilled behaviors undertaken at a nonconscious level of cognitive processing, resulting in minimal cognitive load. However, due to poor design or operator error, an operation can fail. When an operation fails, the user can reverse engineer the operation.

An operation can be reverse engineered as an action by conceptualizing the skilled behavior. However, this is accompanied by a high extraneous cognitive load, as each step is a consciously controlled decision in a process that requires additional resources from the available but limited resources of working memory. On the completion of this process, germane resources in working memory then process the new information and store it in long term memory. Figure 1 outlines the structure and relationships between working memory resources and cognitive load.

**Table 1.** The Alignment of Blackler’s (2006) Design Principles with Best Practice Design Guidelines by Shneiderman and Plaisant (2010), Nielsen (1993), and Norman (2004).

Principle	Best Practice Guidelines			
	Blackler	Shneiderman	Nielsen	Norman
Familiarity in the domain		Strive for consistency. Reduce short-term memory load.	Simple and natural dialogue. Speak the user’s language.	Use knowledge in the world and knowledge in the head. Map the familiarities accurately. Make things visible, bridge the Gulfs of Execution & Evaluation.
Metaphors from other domains		[not addressed]	Speak the user’s language.	Get the metaphor mappings right. Use knowledge in the world and knowledge in the head. Make things visible, bridge the Gulfs of Execution & Evaluation.
Redundancy and consistency		Strive for consistency. Reduce short-term memory load.	Consistency	Use both knowledge in the world and knowledge in the head. When all else fails, standardize.



**Figure 1.** Working memory structure illustrating the relationship between working memory resources and the allocation of those resources to manage the cognitive load associated with a user interface learning experience. The percentage of working memory resources and cognitive load allocated to a particular task vary with each task.

Conversely, to operationalize an action as a skilled behavior requires both extraneous and germane resources in working memory. Once the action is operationalized, the extraneous cognitive load is minimal because the user no longer is required to interpret the artifact or the situated action. The intrinsic cognitive load is also light as the actions and operations are integral to the adopted script for the interaction sequence.

A familiar example of operationalization is learning to drive a manual transmission car. Initially, a driver closely monitors and manages every interaction with the vehicle’s controls. The germane resources in working memory are utilized for the overall activity of monitoring the car, controlling one’s manipulation of the various systems, and keeping safely on the road. The extraneous resources are utilized to pay attention to all the physical interactions necessary to control the vehicle, specifically, to steer, brake, accelerate, press the clutch, and change gears. As experience is gained and the confidence level in driving skills rises, the vehicle’s control interactions become semiautomatous skilled behavior. The extraneous cognitive load correspondingly declines, freeing working memory that can be utilized, if necessary, as germane resources servicing the intrinsic cognitive load of driving the car safely.

Similarly, when an individual is learning how to interact competently with unfamiliar software, the need for additional mental resources in working memory increases the extraneous cognitive load at the expense of the intrinsic cognitive load. This underscores the reason for keeping usability at the forefront in design. If the software cannot be used to obtain the anticipated outcomes, it is impossible to assess whether the software is in fact useful. Usability is the key to determining usefulness, and fit for purpose assessment needs to consider both usability and usefulness.

Usability is a function of the affordances of the screen artifacts. Good usability has its foundation in the system designer knowing the practice of the targeted user cohort (Buxton, 2010). Distributed cognition is the HCI paradigm that best defines what is required for good usability. The affordances of the artifact, which is the vehicle of distributed cognition, are the use-community's praxis crystallized in the artifacts: They transport the history of use and use possibilities across time, location, and the population of the CoP (Lehane, 20012a). These characteristics are the requirements for intuitive interaction.

However, there will be instances of an individual having little or no prior experiential knowledge. In these cases, the help resources of a system should aid in the operationalization of the unfamiliar actions. The help resources should contain explicit step-by-step instructions, obtained from the conceptualization of the operations, to scaffold the user's learning. In this way, the help resources provide a do-as-you-go learning environment that provides partially completed operations as a sequence of procedures to assist the learning and operationalization of the action (Bandura, 1978, 1986, 1997, 2001; Knowles, 1984; Rogers 2002; Sweller et al., 2011). Means to meet this requirement can be presented via, for example, narrated video presentations using screen designs of the system in use and documents that are graphic novelettes with text and images to illustrate the interactions required.

Help resources designed to this paradigm reduce the stress and the cognitive load of learning to use the system. They require fewer extraneous resources in working memory and facilitate more germane resources for the intrinsic cognitive load, if it is required.

## **Mental Processing**

The prerequisite for intuitive use is leverage of prior knowledge with an accompanying skill base and light cognitive load (Buxton, 2010). The context necessary for recognition to trigger possible intuitive interaction is the reproduction of the user's internal knowledge on the screen: the visibility tenet of HCI design. The act of seeing the screen design impacts on the user's mental processes at three levels: visceral, behavioral, and reflective (Norman, 2004).

The lowest of these three levels is the visceral, which responds to sensory stimuli and initiates motor behavior. The visceral is the instinctive processing that instantaneously makes a value judgment on what is good or bad (physically, mentally, and emotionally) and sends appropriate signals to the muscles and to parts of the brain, typically without initial consciousness. The second level is behavioral, which also responds to stimuli and can initiate behavior. The behavioral level can be influenced by the reflective level, whereas the visceral cannot. The highest level is the reflective level, which is isolated from the sensorimotor actuators. It monitors the behavioral and visceral levels and influences behavior.

Affective processing, which includes emotional response, starts with the visceral. Everyday behavior, best described as skilled or operationalized activity without conscious



consideration of the activity, is the behavioral level. Finally, the reflective level involves conscious cognition, the contemplative processing of past, present, and proposed experiences.

The cognitive load associated with the use of prior knowledge is a function of the activity's plans, the action levels of mental processing, and the implementation of skilled behavior for the predetermined operations (Buxton, 2010). Rasmussen (1994) classified the different types of information processing required to use "ecological information systems," his term for software programs used in the workplace. The three processing classifications are skill, rule, and knowledge (SRK). Together, they indicate the amount of conscious control a person has over his/her interactions with the system. Blackler's (2006) rationale for the intuitive design criteria and Lehane's (2012a) system acceptance indicator (SAI) were both established using the SRK processing classifications.

Skilled processing is in response to observed signals that trigger highly practiced physical operations that are associated with automatic nonconscious cognitive load. Signals are visceral in that they initiate a low-level automatic response. Signs are visual system characteristics that trigger the mental application of a rule associated with that characteristic or the use of knowledge to generate an appropriate response. The implementation of a rule is intuitive and contextually sensitive. Depending on the context, the rule may be applied nonconsciously or its application may involve some conscious involvement and a light cognitive load. The use of knowledge in response to a sign is a controlled conscious process that can impose a moderate-to-heavy cognitive load, depending on the circumstance. Knowledge work requires reflection to formulate plans based on schema-derived scripts.

Screen design should facilitate the SRK paradigm. Norman's (2004) levels of mental processing and Rasmussen's (1994) information processing hierarchy align mental processing of information with levels of consciousness and behavior. Consideration also needs to be paid to reflective mental processing undertaken as a postbehavior assessment of an activity. This analysis of screen design requirements indicates that reflective assessment needs to consider three knowledge sources:

- knowledge from the skilled and automatic use of signals as transparent symbols;
- knowledge from the intuitive and possibly conscious use of signs as familiar symbols;
- knowledge from the controlled and conscious use of unfamiliar or seemingly familiar symbols.

These knowledge constructs interleave with the operation, action, and activity hierarchical interaction structure of activity theory (Bødker, 1991; Nardi, 1996). Table 2 presents these elements and how they interlink as the requirements for intuitive design of an activity. The extended continuum provides an overview of the relationships between the constructs and their interdependence. To undertake an activity, the objective must be determined from the context of the situation (Buxton, 2010; Checkland, 1999; Suchman, 1987). Consequently, the objective is emergent from the individual's inherent plans and scripts that shape the environment and the activity.

## **Intuition Elements**

The proper selection of screen artifacts and appropriate screen layout from the users' CoP (domain) is essential for intuitive interaction. The computer domain comprises myriad CoPs. An oft quoted but not attributed mantra is "know your user." An extension of this is "know your users'

**Table 2.** Map of Mental Processing Across the Levels of Cognition, Knowledge, and Context.

Mental processing	Cognitive processing	Level of consciousness	of Extraneous cognitive load	SRK model of task performance	Activity theory
Visceral	Automatic, unconscious engagement	Process is non-conscious	Negligible	Skill–practiced operations with automatic nonconscious cognitive load	Evaluate contextual environment
Behavioral	Intuitive, with some conscious engagement	Possibly some conscious involvement	Light to medium	Rule–nonconsciously applied or some conscious involvement and a light cognitive load.	Contextually triggered scripts for observable behavior
Reflective	Controlled, with fully conscious engagement	Process is conscious	Light	Knowledge–from skilled use and comfortable with use of transparent symbols	Operations - contextually triggered expertise
		Process is conscious	Medium	Knowledge–from intuitive use and comfortable with use of familiar symbols	Actions - contextually scaffolded stages
		Process is conscious	Heavy	Knowledge - from conscious use and comfortable with use of unfamiliar symbols	Activity - conceptually familiar

community of practice” (Lehane, 2012c). A CoP has common practices (praxis) for use and design of its tools. The manner in which the community experiences its practices is explained by the HCI paradigm of distributed cognition (Hutchins, 1995, 2000) and is crystallized in the affordances of the artifacts used. The affordances propose the artifact use possibilities and the methods of use. Identifying the artifacts and understanding the use practice provides insight into the why that is fundamental to the what, when, where, and how of screen and system design (Lehane, 2012a, 2012b, 2012c).

The intuitive interaction continuum assimilates Blackler’s (2006) three principles for intuitive interaction:

- use familiar features from the same domain;
- transfer familiar things from other domains;
- [implement] redundancy and internal consistency.

Designing with the implicit HCI intuitive guidelines and Blackler’s principles as the primary focus brings as many as possible already known elements into the design. The other HCI guidelines and the functionality to support the required tasks are a secondary focus implemented as appropriate to the stage in the design progress.

The primary focus creates a context that generates a positive visceral response. The secondary focus provides rules and onscreen knowledge for successful interactions based on behavioral knowledge and existing expertise and experience.

## Assess Intuitive Design

The research into intuition identified three essential elements as being necessary for the emergence of intuitive interactions.

1. A context that presents visual triggers for prior knowledge and expertise to be expeditiously and nonconsciously accessed prior to initiating a scripted behavior for a particular action and subsequent operations.
2. Initiating the interactions scripted by the suggested familiarity of the novel situation.
3. Completion of the interactions delivering the outcomes suggested by the familiarity, thereby confirming the successful leverage of prior knowledge.

The requirements for intuitive use have been identified and discussed. However, the question arises as to how intuitive design can be evaluated, along with the corollary of how to use the feedback to improve both the design and the design process. Anecdotal evidence alone makes it difficult to validate and verify. It would be advantageous to have an instrument that could be readily applied with consistent reproducible results.

The unified theory of acceptance and use of technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003) integrated technology acceptance and use concepts. Previous work on the evaluation of design produced the SAI (Lehane, 2012a). The development of the SAI mapped the SAI questions to the UTAUT question sets and theoretic frameworks (Lehane 2008; Lehane & Huf, 2007). The SAI is a validated survey instrument that can be used to evaluate system use within an HCI designed technology acceptance framework. Previously, Blackler's (2006) three principles of intuitive interaction were shown to align with existing principles for HCI design. Therefore, Blackler's principles should be able to be evaluated using the SAI.

The SAI is a survey instrument of 25 statements that are assessed using a 5-point Likert agreement scale. The responses are mapped to usability engineering concepts of system acceptance, usefulness, functionality, utility, and usability. This is achieved by mapping the elemental properties of active user, distributed cognition, affordances, immersion in the CoP and the context of the work environment onto the usability engineering concepts (Lehane, 2010). The SAI question set was reviewed and six questions were considered to form a concise subset that describes the developed intuitive mental processing schema. Table 3 presents the SAI questions, their UTAUT determinant, and the theoretical basis for the inclusion of the question in the question set.

The mental processing and screen design aspects associated with each question are presented in Table 4. This table outlines the suitability of each question for evaluating the associated mental processing.

A comprehensive reflective assessment of an activity considers all three mental processing activities and the predominant screen design aspect impacting on the mental processing. Thus, the GUI designer considers the initial visual impact. The DMI/NUI aspects are considered for the perception of the on-screen affordances, interaction inputs for an outcome, and the outcome itself. Visceral and behavioral processing are separate stages but, by its nature, reflective assessment must contemplate the skills and behaviors as well the overall activity. The question set should facilitate this and be able to assess the intuitive qualities of the screen design, screen layout and the interaction design:

**Table 3.** SAI Questions as a Statement for Agreement with its Associated UTAUT Determinate and Technology Acceptance Theory.

SAI Questions	UTAUT Determinate	Technology Acceptance Theory
Q1. The screen for this software looks like other screens I have used.	Effort expectancy: perceived ease of use (Key concept: skillful)	Technology Acceptance Model <sup>1</sup> & Innovation Diffusion Theory <sup>2</sup>
Q2. When I look at the icons and menus, etc., on the screen I know what to use and how to use it.	Effort expectancy: perceived behavioral control/ease of use (Key concept: clear & understandable)	Technology Acceptance Model & Innovation Diffusion Theory
Q3. For the things that I use, this software looks and works the same way every time.	Effort expectancy: perceived behavioral control/ease of use (Key concept: software does what I want it to do)	Technology Acceptance Model & Innovation Diffusion Theory
Q4. There is always enough information on the screen when it is needed.	Facilitating conditions – perceived behavioral control/perceived usefulness (Key concept: flexible)	Technology Acceptance Model & Theory of Planned Behavior <sup>3</sup>
Q5. I think I will be able to use this software without asking for help from the experts who know how to use it.	Facilitating conditions: perceived behavioral control/ self-efficacy (Key concept: knowledge)	Technology Acceptance Model & Theory of Planned Behavior & Social Cognitive Theory <sup>4</sup>
Q6. I would recommend this software to a colleague or friend.	Social influence: social factors (Key concept: recommend)	Model of PC utilization <sup>5</sup> & Social Cognitive Theory

*Notes.* 1. Models how users accept and use technology (Davis, as cited in Venkatesch et. al., 2003). 2. Rational for the rate of dispersion of new ideas and technology (Rogers, as cited in Venkatesch et. al., 2003). 3. Explain behaviors over which people can exert self-control (Mathieson, as cited in Venkatesch et. al., 2003). 4. Knowledge acquisition occurs in the context of social interactions (Bandura, as cited in Venkatesch et. al., 2003). 5. Knowledge acquisition occurs in the context of social and technological interactions (Compeau & Higgins, as cited in Venkatesch et. al., 2003).

**Table 4.** Mental Processing and Associated Questions Relating to Screen Design Aspects.

Mental Processing	SAI Questions	Screen Design
Visceral—influenced by skill	The screen for this software looks like other screens I have used.	GUI aspects
Behavioral—influenced by rules	When I look at the icons and menus, etc., on the screen I know what to use and how to use them.	DMI/NUI aspects
Reflective—influenced by skill knowledge	For the things that I use, this software looks and works the same way, every time.	GUI and DMI/NUI aspects
Reflective—influenced by action knowledge	There is always enough information on the screen when it's needed.	GUI and DMI/NUI aspects
Reflective—influenced by meta knowledge	I think I will be able to use this software without asking for help from the experts who know how to use it.	GUI and DMI/NUI aspects
Emotional	I would recommend this software to a colleague or friend.	Response that assigns value to objects or events

*Note.* GUI is the graphical user interface; DMI/NUI is direct manipulation interface/natural user interface.

- Question 1 initial reaction to the user interface;
- Question 2 confirms Question 1;
- Question 3 confirms Question 2;
- Question 4 confirms findability and usefulness for an active CoP member;
- Question 5 confirms the design uses the practice of the user’s CoP;
- Question 6 confirms the previous question set with an emotional personal association by the survey participant (ownership).

The previous sections discussed the characteristics of intuition and identified three elements required for intuitive interaction. The three elements are familiar user expectations, confident interactions, and the successful leverage of prior learning. The SAI intuitive use subset of questions is pertinent to these concepts.

An assessment instrument must allow results to be interpreted consistently over a diversity of projects. Table 5 provides a summation table that associates each question of the SAI on screen design with an activity theory concept, the SRK model for information processing, and Norman’s mental process. A low response for an individual question indicates that that element of the design criteria requires attention by way of fieldwork and/or design review.

A high level of agreement demonstrates that the screen design followed the practice of the users’ CoP and thus the extraneous cognitive load of users will be low. In such a case, the system allowed the users to draw on their extant knowledge and skills for intuitive interaction with the visual, graphic, interaction, navigation, and information elements of user interface.

The question set was used to evaluate the intuitive use of a new software system at a regional university in Australia. I present the case study in the next section.

**Table 2.** System Design Criteria Applicable to the SAI Statements for Agreement.

<b>SAI Question</b>	<b>Design Criteria</b>	<b>Activity Theory</b>	<b>SRK MODEL</b>	<b>Mental Process</b>
The screen for this software looks like other screens I have used.	Usability, distributed cognition, affordances	Evaluate contextual environment	Skill—sign	Visceral
When I look at the icons and menus, etc., on the screen I know what to use and how to use them.	Usability, distributed cognition, affordances	Contextually triggered scripts	Rule—signals	Behavioral
For the things that I use, this software looks and works the same way, every time.	Usability, distributed cognition, affordances	Operations - contextually triggered expertise	Knowledge from skilled use; comfortable with use of transparent symbols	Reflective
There is always enough information on the screen when it’s needed.	Usability, distributed cognition, affordances	Actions contextually scaffold stages	Knowledge from intuitive use; comfortable with use of familiar symbols	Reflective
I think I will be able to use this software without asking for help from the experts who know how to use it.	Depth of immersion in CoP	Activity within conceptually familiar schemas & scripts	Knowledge from conscious use; comfortable with use of unfamiliar symbols	Reflective

## THE CASE STUDY

In this section, I discuss the design and development of the academic staff interfaces presented in the Introduction. The discussion focuses on the screen and interaction design to meet the staff user requirement that the system enables users to complete the required tasks without formal training. The overall design of the system and user interfaces for all user classes is out of scope for this paper. However, a paper discussing the design for the screens, interactions, and user experience is proposed.

The preamble on intuitive design and interaction outlines the theoretical considerations given to the design of all the system's user interfaces (UIs). The HCI design paradigm used for the development process was the spiral life cycle model (Boehm as cited in Preece et al., 2007; Winston, 1970) applying user-centric rapid application development (Millington & Stapleton as cited in Preece et al., 2007).

Progress reviews evaluated the work by using Checkland's (1999) five measures of performance:

- efficacy—successful in producing the required output
- efficiency—the minimum resources are used to obtain the output
- effectiveness—the processes modeled are indispensable
- ethics—the process has moral integrity
- elegance—the overall design and its elements are aesthetically pleasing.

There is a caveat to elegance in that the aesthetics of graphic design must never take precedence over usability.

The programming for the CLSE system was based on a survey life cycle (SLC) that incorporated, but was not limited to, functionality for the design and development of the survey question set, managing the opening and closing dates for the stages of the SLC, changing the data sets displayed with each life cycle stage, controlling security and access to personal and corporate data, ensuring that legacy question sets could not be changed after a survey was closed, and generating reports. The SLC programming also included control of progress through the SLC and the CLSE processes.

The brief required that the academic staff interfaces were to be accessible on devices ranging from notebooks to desktop computers and use the dominate browsers for Microsoft, Android, and Apple operating systems. To meet this platform specification, a responsive design was the goal, rather than developing a separate application for the mobile solutions. Mobile phone platforms with their small screens and onscreen keyboards were excluded from the brief due to their potential to cause usability issues in reading and inputting data.

The design brief was quintessentially short: A CLSE system that the academic staff could interact with without training in the use of the software or training in their role for course-level student evaluation. Over a period of years, while running training workshops, the university's course evaluation and survey officer had identified and recorded shortfalls in functionality, on-screen information, and software use issues. Consequently, the new system's functional requirements for academic staff were documented in detail. This evidence-based research was invaluable as it established the usability and functional requirements.

The design process took place within three sequential but overlapping phases—nominal, descriptive, and formative—in line with ecological interface design principles (Vicente, 1999). The nominal phase analyzed the current system and reviewed the already documented evidence-based requirements; the descriptive phase investigated the contextual-use requirements

of the current system and the current shortfalls. The formative phase encompassed the design and development phases undertaken after detailing the use requirements and the desired outcomes of the future system. The formative phase also incorporated the initial design of the required outcomes, the processes to deliver the new UIs, the associated interaction designs, and the coding of the business rules and screens.

Gestalt and aesthetic considerations proved important in the design and presentation of the information on the screen. With placement, text, and color choices, the graphic designer improved the readability of important but previously mundane notices. Quality graphic art represents an important aspect of screen design because positive initial visual impressions are critical for usability and system acceptance. However, aesthetics must never take precedence over usability: If graphic design dictates that an object should be on the right side of the screen but usability precedence dictates that users expect the object to be on the left, then the object must be placed on the left.

Academic personas were developed to identify the predominate subsets of staff user characteristics, academic roles, IT experience, and attitude toward the various technologies used. The personas grounded the use cases with evidence-based issues that identified the pros and cons of existing and proposed functionality and screen layout. The selection of screen artifacts for interaction controls, such as icons and terminology, was drawn from the Microsoft pallet because the university specifies Microsoft products for use by staff and students. Apple products are supported but not specified for staff and student use.

Academic subject matter experts (SMEs) were brought into the process early in the development of each set of screens that supported an individual activity. The selected SMEs possessed attributes identified in the purposive sampling matrix that was developed from the personas. Various levels of expertise and experience were sought in areas of academic role, familiarity with CLSEs, familiarity with the previous CLSE software, IT skills, and English-as-a-second-language experience.

Changes to the layout and changes to the academic terminology were based on the recommendations of the academic SMEs. Where the SMEs had difficulty in using the software or understanding the terminology, designers modified the software to fit their mental models. The SMEs first exposure to a design was to step through the proposed interaction design on a wireframe. Feedback was sought on all aspects of screen design: the on-screen artifacts, screen layout, terminology, and the sequence of the steps to progress through the process, as presented on the wireframe.

The first screen was produced after the initial mock-up and test. The SMEs were brought back to review subsequent versions of the screens, the interaction design, and the help resources. Multiple reviews resulted in identified issues requiring changes to the screen design and the help resources. The help resources of the case study were designed using the best practice adult learning (Bandura, 1978, 1986, 1997, 2001; Knowles, 1984; Rogers, 2002) and instructional design principles of cognitive load theory (Sweller et al., 2011).

The screen reviews, on occasion, identified places in the process where the interaction design needed to constrain the available branching options to ensure the process proceeded as required. In other cases, the interaction design required modifications when a screen had to be expanded to two screens to accommodate the process or when two screens had to be condensed into one to constrain the process.

Information relating to various aspects of software use or information about the CLSE process and role specific responsibilities were allocated separate areas on the screen. The

location, area allocated, and color reflected best practice usability and the relative importance of the information in the CLSE process. Gestalt and aesthetic principles were applied to the overall layout, the design of sections, and the allocation of fonts, line spacing, and color. The location, shape, and color of icons and the design of other on-screen artifacts for monitoring and control were tested by experienced and novice computer users to ensure a base level of use-familiarity and outcome expectations.

The on-screen information and the page-specific help resources were designed and developed to scaffold the academic staff through their assigned activities. The help function used multimedia and text formats. The videos were produced to enhance the learning experience for staff members without experiential knowledge of CLSE or the survey editing process and to assist nonnative users of English.

During design discussions, the various activities associated with the tasks were identified. The various activities were termed “what brings them to the screen.” In this perspective, “them” encompassed all the proposed classes of users of the CLSE system. This allowed for consideration of the inputs and outcomes of each activity, its associated functional requirements and related data fields, as well as the interactions to monitor and control each activity of the task.

By way of example, a number of activities can bring a staff member to the screen. For instance, a staff member can access the software to review a survey about to be run, monitor the response rate of an open survey, or provide examiner feedback. Each stage of the survey life cycle brings implications for the staff, the students, and the system administrator. The set of screens designed for each audience at each stage underwent the same rigor of design outlined in this section. An overview of the staff screens developed for the CSLE system is presented in the following section of the paper.

## **STAFF USER INTERFACES**

In this section, the discussion of staff UIs covers intuitive use in more detail. However, stepping through the interaction design for each screen to assess the user experience is the focus of a separate user experience paper under consideration.

The staff UIs were developed from the scenarios of situated actions (Buxton, 2010; Carroll, 2003; Suchman, 1987). The screens and interactions were designed to support the academic staff in the following activities.

The teaching staff role involves

- reallocating the examiner role if he/she is not the course’s examiner;
- checking that all courses are listed, and if not, contacting the examiner to be added to the staff for the course;
- making sure all staff for evaluation are listed by name, if this feature is offered for the survey;
- previewing the survey, checking any questions that have been added to the survey by the examiner, and discussing options for additional questions from the approved question list with the examiner; and
- reviewing the evaluation to see what the students are going to see.

An examiner’s editing role entails

- checking that all his/her allocated examiner courses are listed;
- checking that all staff teaching the course are attached to the course;



- removing any staff listed who are not teaching the course;
- allocating staff for evaluation, if this feature is offered for the survey (students will see the staff member's name);
- adding questions from the list of approved questions, if appropriate;
- reviewing the evaluation to clarify what the students are going to see;
- monitoring the status of the survey;
- monitoring response rates; and
- accessing reports and provide examiner feedback as appropriate.

After selecting the current survey campaign on the staff landing page, the courses in that survey iteration for which the staff member is either examiner or teacher are presented in a list. A segment of this course list is presented in Figure 2. Course description, academic role, and SLC status are displayed for monitoring the courses progress throughout the SLC.

Specific courses in a person's list can be found using the search function; a course that has not been associated with a person also can be accessed using the search function. The system's search functionality supports search, filtering, and sorting all data contextually relevant to that screen. Selection of the Edit button opens the course for editing. Even after an initial editing, a course survey can be modified while the survey campaign is open for editing. Teaching staff who are not the examiner can preview the survey by selecting the Preview button.

Teaching staff also can view the pool questions from the preview. Pool questions are additional questions that the survey owner has the option to ask. Access to the pool questions allows the teaching staff and the examiner who may be on different campuses to simultaneously view and

**CURRENT SURVEYS**

2016, S1, Week 5 - Course Evaluation, Coursework Courses (Survey 6) EDITING OPEN Editing closes on 29/06/2016 View Courses

Search for course

Code	Description	Campus/Mode/Term	Role	Reviewed
CMS1000	Communication and Scholarship	TWMB ONLINE Semester 2, 2015	Examiner (change) <span>Edit</span>	-
ENG1101	Introduction to Engineering Problem Solving	SPRNG ONCAMPUS Semester 2, 2015	Examiner (change) <span>Edit</span>	-
EDC1100	Lifespan Development and Learning	TWMB ONCAMPUS Semester 2, 2015	Examiner (change) <span>Modify</span>	<span>Preview</span> <span>✓</span>

Display 20 records Showing 1 to 3 of 3 entries Previous 1 Next

SEARCH FOR MISSING COURSES BY COURSE CODE TO REQUEST ACCESS:

If your course does not appear in the search please contact [course.evaluations@usq.edu.au](mailto:course.evaluations@usq.edu.au)

**Figure 2.** Academic staff view of the staff landing page that lists the surveys currently running for courses in which the academic staff member has either examiner or teaching responsibilities.

discuss possible additional questions conveniently over the phone. This helps to shorten the timeline for survey development. An edited survey has a green tick in the Reviewed column and is available for modification. The Reviewed status is useful for monitoring the completion rate of the editing process. Once a survey is open to the students, the Reviewed column data are replaced with a column showing the student response rate as a percentage and tally.

## The Editing Process

The editing process was developed as a five-step procedure with individual screens to scaffold the user through the process:

- confirm examiner and teaching staff;
- set up staff evaluation (if part of the survey);
- review questions and add questions, if appropriate;
- preview the survey;
- mark as reviewed.

Progress through the editing process is monitored by the course review progress bar. The icons for each stage in the process are links to the screen for that stage. As each stage is completed and saved, a green tick replaces the stage number in the icon. Video and text help resources are available, as well as a Back button for navigation.

The first editing screen, as shown in Figure 3, asks the fundamental question of course ownership to establish/confirm examiner rights or teaching staff only access. The development of this functionality to control access to the survey and examiner rights allowed the academic

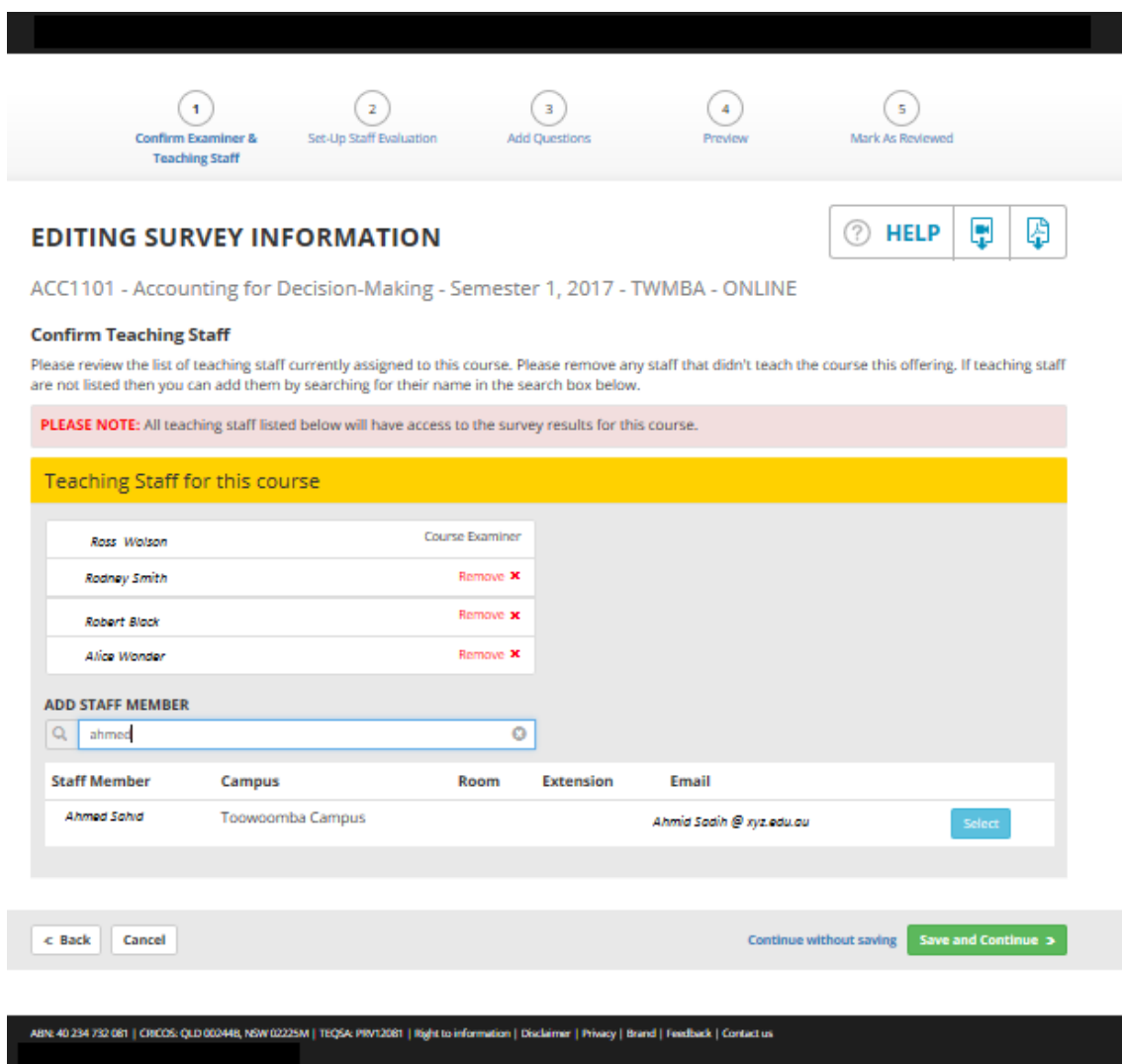
**Figure 3.** The Examiner Rights screen allows academic staff to establish their relationship to the course and the survey. An examiner has privileges for editing survey that a nonexaminer, teaching only, staff member does not.

staff to make any required changes to staffing without assistance from the system administrator, thereby empowering academic staff.

A “No” response to the examiner rights opens an overlay that, on completion, initiates an email to the new examiner. The previous examiner is then reassigned to a teaching staff role and returned to the landing page. A “Yes” response calls the next screen to confirm the teaching staff.

The screen to confirm teaching staff, Figure 4, has the same visual appearance as the first screen in the process: progress bar, page-specific video, and text help. Additional CLSE information is presented on the screen above the associated data fields and control artifacts.

Academic staff associated with the course in the university’s academic database are the default teaching staff for the course. The examiner can remove the default-entered staff if they are no longer associated with the course, and new staff can be added using the search function.



**Figure 4.** The Confirm Teaching Staff screen is a responsibility of the course examiner after his/her role has been confirmed on the previous screen. This screen facilitates the addition or removal of teaching staff (fictitious names in the figure) from the list of staff who can access the survey and the survey reports.

The interactions to search for and select new staff are guided by the use of familiar screen artifacts, text fields, icons, and on-screen instructions.

Information relating to the process is presented first as an overview to provide context. Then the actions in the required sequence for this stage of the CLSE process are identified, along with the controls for each action. Working with the document takes the reader through the cognitive and behavioral procedures necessary to complete the process. Steps that are not applicable can be skipped. The last instruction explains how to proceed to the next stage of the CLSE process.

The page-sensitive help resources for the system were developed to instruct and guide a person requiring assistance to engage with the necessary interactions and to explain the importance of each stage in the CLSE process. Thus, in this context, the Confirm Teaching Staff help pdf (see Figure 5) is presented to explain the help document format.

The third step in the process is the editing of the survey itself. The visual appearance and navigation are unchanged. However, the second stage icon will indicate that stage has been completed and saved, as demonstrated in Figure 6.

The survey questions are grouped by evaluation type and response rating scale. The questions are either core for the survey or optional questions from the pool. The inclusion of pool questions is at the discretion of the examiner and can be added or removed at any time prior to the survey being released.

The final stage of the editing process is to review the survey. This screen, shown in Figure 7, allows the examiner and teaching staff to see the survey as the students will see it. The Preview Student View screen also allows the teaching staff access to the pool questions. Only the examiner can add pool questions to the survey but teaching staff can review the pool questions available and make requests to the examiner to have pool questions added.

The report section closes the CLSE process. The reports are open to staff and students after they have been checked by the system administrator to ensure there are no system errors affecting the results. The reports provide each student with a copy of their individual responses and a nonidentifiable aggregated summation of their cohorts' responses and comments. Staff can access nonidentifiable aggregated summations of class responses and comments.

The report, shown in Figure 8, presents the data in a series of formats: mean comparison or response frequency with vertical or horizontal graphs. The viewer can select the desired presentation format. The extensive detail of the quantitative data analysis is not reported in this paper. The help resources explain in detail the rationale for the statistics used and the interpretation of the aggregated data.

Student comments on the courses are also displayed in the reports and provision is made for examiners to provide feedback to current students and the next cohort taking that course. The provision of examiner feedback completes the communications loop of (a) asking the initial question, (b) receiving a response and any additional comments, and (c) providing feedback to the additional comments.

The screens discussed illustrate how the intuitive guidelines were implemented in the context of supporting the academic staff to manage their role and associated responsibilities in a survey campaign.

## Surveys Help

### Confirm teaching staff

This is the screen where you review and update the teaching staff for this Course (campus and mode).

---

The data for the system is drawn from Peoplesoft: teaching staff are not always correct.

**NOTE:** It is important that the teaching staff are correct as all staff listed on this screen can view the reports.

---

You can remove staff who are not teaching this course (campus and mode) by clicking on the **Remove** ✖

**EDITING SURVEY INFORMATION**

PMAC1102 - Preparation for Paramedic Practice 1 - Semester 1, 2015 - IPSCH - QNCAMPUS

**Confirm Teaching Staff**

Please review the list of teaching staff currently assigned to this course. Please remove any staff that don't teach the course this offering. If teaching staff are not listed then you can add them by searching for their name in the search box below.

**Warning Note:** Removing staff from this list will have a direct effect on the survey results for this course.

HELP

**Teaching Staff for this course**

Pat Lehane Remove ✖

Susan Goodall Course Exemptions

**ADD STAFF MEMBER**

Back Cancel

Save and Continue >

You can add staff using the add staff member function.

Search for the staff member by name.

You can search on first name or last name and if you are not sure of the correct spelling the search will autocomplete after the first three characters.

In addition to the staff member name you will see details to assist you to identify the correct person.

When you have identified the correct person click **Select** to add them to the Teaching Staff for the course.

**Teaching Staff for this course**

Pat Lehane Remove ✖

Susan Goodall Course Exemptions

**ADD STAFF MEMBER**

Staff Member	Campus	Room	Saturation	Email	Select
Alexander Cosio	Toowoomba Campus	Y225	2018	Alexander.Cosio@triac.edu.au	Select

Back Cancel

Save and Continue >

Once you have finished updating the teaching staff click on **Save and Continue >** to move to the next editing screen

**Figure 5.** The Confirm Teaching Staff Help pdf is text format help resource that provides a step by guide to adding or removing a staff member from the list of people who can access the survey and the survey reports.

Confirm Examiner & Teaching Staff Set-Up Staff Evaluation **3** Add Questions Preview 4 Mark As Reviewed 5

## EDITING SURVEY INFORMATION

ACC1101 - Accounting for Decision-Making - Semester 1, 2017 - TWMBBA - ONLINE

### Add Questions

The survey administrator has selected a set of standard questions for this survey. These questions have been listed in the sections below. As examiner you may select additional questions from the question pool to be added into a survey section. Click the "Add Questions" button to see the additional questions available. You cannot remove, edit or sort the questions set by the administrator.

**Course Agreement scale 5 pt** (Strongly Disagree;Disagree;Neither Agree nor Disagree;Agree;Strongly Agree)

Overall I am satisfied with this course.	Click for more details	Administrator Question
Assessment tasks contributed to my learning in this course	Click for more details	Administrator Question
The non-assessed online tasks contributed to my learning in this course	Click for more details	Administrator Question

**Add Questions** 0 optional questions selected. Maximum allowed is 2

**course Free Text**

What were the best aspects of this course?	Click for more details	Administrator Question
--	------------------------	------------------------

[Back](#) [Cancel](#) [Continue without saving](#) [Save and Continue](#)

ABN: 40 234 732 081 | CRICOS: QLD 002448, NSW 02225M | TEQSA: PRV12061 | [Right to information](#) | [Disclaimer](#) | [Privacy](#) | [Brand](#) | [Feedback](#) | [Contact us](#)

**Figure 6.** The Review the Survey Questions screen presents the questions proposed for the survey. The questions are grouped by response format. For example, all 5-point agreement scale questions are shown together and separate from the free-text questions. The examiner can add additional questions from a prepared secondary question set.

## INTUITIVE USE ANALYSIS

The six items from the SAI question set selected for *intuitive use evaluation* were discussed and presented earlier in the paper. The SAI is a validated survey instrument for assessing system acceptance using models, theories, and frameworks from the discipline of HCI. The intuitive use subset was determined from current research into intuition, where intuition is defined as reusing pre-existing experiential and formal knowledge in a novel situation.

Prior to using the survey, ethics approval was sought from and given by the University's Ethics Committee. An email with a link to the survey was sent to all academic staff who had

[Redacted]

✓  
Confirm Examiner & Teaching Staff

✓  
Set-Up Staff Evaluation

✓  
Add Questions

4  
Preview

5  
Mark As Reviewed

### EDITING SURVEY INFORMATION

ACC1101 - Accounting for Decision-Making - Semester 1, 2017 - TWMB - ONLINE

?
HELP
[Print]
[Share]

PREVIEW STUDENT VIEW
Mark As Reviewed >

Course	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Overall I am satisfied with this course.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					
Assessment tasks contributed to my learning in this course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					
The non-assessed online tasks contributed to my learning in this course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					
I found the assessment in this course reasonable <small>Question added by examiner</small>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					

[Skip to staff evaluation](#)
[Skip to end OR continue...](#)

#### COURSE

What were the best aspects of this course?

Enter your comments

[Skip to staff evaluation](#)
[Skip to end OR continue...](#)

#### Staff Evaluation

Patrick Lehane	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The staff member clearly explained what I was required to do in assessment tasks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					

[Skip to end OR continue...](#)

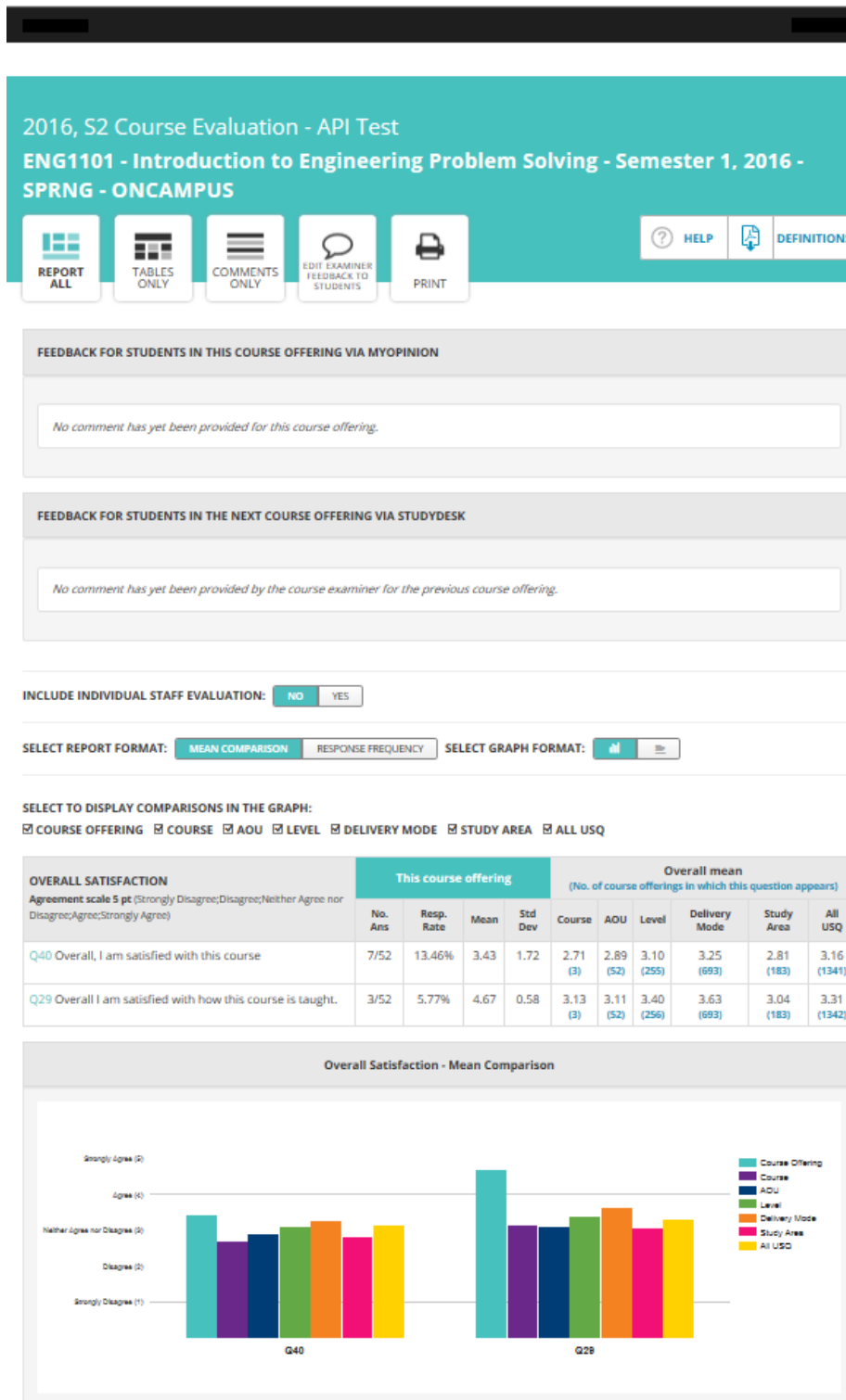
Other teaching staff
▼

Other teaching staff	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The staff member clearly explained what I was required to do in assessment tasks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<small>COMMENT</small> ▼					

Please review your answers and then submit your survey!

Submit Survey

**Figure 7.** The staff Preview Student Survey screen presents the staff member with the same view of the survey that the student will see. This allows the examiner to consider changes to the survey and observe how those changes will influence the look and feel of the survey.



**Figure 8.** The survey reports are extensive. This figure displays the top section of a final report. Student comments and academic staff responses to those comments are available, as well as descriptive statistics for the survey participants' responses.



professional responsibilities to access the CLSE system. There were no lead-in or follow-up emails. This convenience sampling method contacted 517 academic staff who had teaching and or examiner responsibilities. There were 399 examiners listed.

The survey received 75 responses, 63 responses were from academic staff who used the CLSE system and 12 from academic staff who indicated that they had not used the CLSE system and gave no explanation as to why not. One participant did not answer any questions other than to claim to have used the CLSE system. Of the remaining 62 participants, 58 responded to all six items relating to their use experience. However, there were only 54 examiner responses. Academic staff with only teaching responsibilities did not use the full functionality available to academic staff and their responses were not included in the data for analysis. Consequently, just the examiner subset of responses was analyzed because their individual data sets covered all interaction aspects of CLSE system use necessary for quantitative analysis, thereby ensuring that correlations between the data items were not biased by unequal weightings or dependence.

The number of examiner responses suitable for quantitative analysis was 54, reducing the response rate to 13.5%. Research by Nulty (2008) indicated that this response rate for a population of this size meets conditions for 10% sampling error and an 80% confidence level, an acceptable rationale to test the data for compliance with conditions for quantitative analysis.

As well as the six questions on the user experience, the survey contained questions relating to the survey participants' prior experiences in course-level evaluation, their individual roles and workloads, the tasks undertaken using the software, and the participants' information technology skill sets. The criteria for assessing experience and information technology skills are presented in Appendix A and are presented to ensure the transparency of the research.

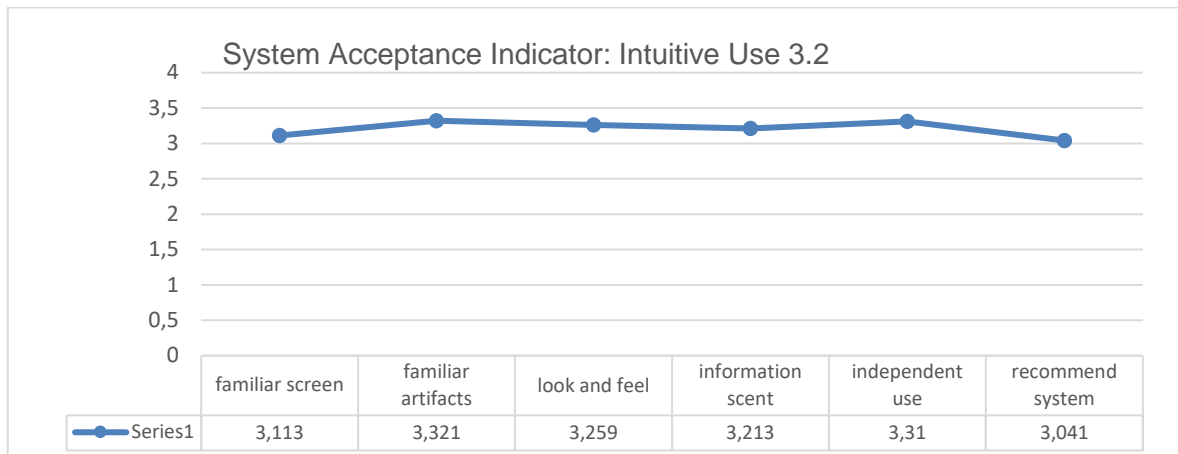
These demographic questions facilitated my identifying factors that may influence large population survey data in an analysis using the full SAI question set (Venkatesh et al., 2003; Lehane, 2008, 2012a). Possible demographic influences on the participant's responses are not discussed in this report because of the small data set.

## **Human-Computer Interaction Analysis**

The SAI calculates the descriptive statistics and then presents the mean value for each question as a plot. In Figure 9, this plot is called Series 1. The intuitive use concepts associated with each question is also presented on the graph; for example, Question 1 relates to familiar screen look and feel. The SAI value range is 0 to 4; a score of 2.5 or greater is indicative of strong user affirmation of an SAI concept or item. A score between 1.5 and 2.5 is affirmation of a concept or item, while a score less than 1.5 indicates that investigative fieldwork should be carried out to identify the issues underlying the low response.

The SAI value of 3.2 for the intuitive use concept is indicative of consistently strong user-affirmations that the design of the user interface and the design of the user interactions facilitate an intuitive user experience. Subsequently, the graphic elements of the GUI, the affordances of the controls of the DMI/NUI, and familiar and confident progress through the required activities may be considered to for analysis be due to familiar screen artifacts that were operated as expected and with the resultant anticipated outcomes.

The CLSE system was designed to facilitate the use of pre-existing experiential and formally acquired computer use knowledge. Where possible gaps existed between a user's knowledge and the needs of the system, online training was provided by the help subsystem. Ultimately, the overall



**Figure 9.** Graph of SAI intuitive use analysis. The Intuitive Use value 3.2 value (overall) results from the average of the responses in the series.

design the CLSE system was deemed successful because the Course Evaluation Survey Office serviced only three help requests.

Three academic staff who had not used the help resources contacted the system administrator for assistance. They were directed to consult the help resources and if they still had problems to make contact again. There was no further contact from these people; apparently, they were successful. Thus, this overall outcome justified the time and resources expended on the development of the help resources. Although contacted for assistance, this was the first time that the system administrator did have to interact with the system itself to service requests for help with the CLSE system.

The anecdotal evidence supported the analytical evidence. On this project, exhaustive programming rigor was maintained in meticulously coding the diverse screen layouts and in analyzing and coding the business processes for the staff UIs. Similarly, instructional design rigor produced best practice adult learning in the development of the help resources. This attention to detail enabled the software to meet the specified requirement to be used without the need for formal training, thus providing an example of best practice in systems interaction design.

### Statistical Analysis: Methodology and Findings

The statistical package used was R and the methods used are documented in publications by Everitt (2010), Field, Miles, and Field (2012), and Yong and Pearce (2013). For this quantitative analysis, measures of internal consistency were used to confirm that the set of survey items assembled to measure the same general construct produced similar scores. A high internal consistency indicates that the items contribute to the understanding of the overall construct. All survey item responses were on a 1-to-5 Likert scale. As noted earlier, response cases with missing data were removed from the data set for quantitative analysis.

### Test for Pairwise Linear Correlation

Pearson's, Spearman's, and Kendall's pairwise correlations are measures of the linear correlation between two variables. These correlations were calculated from the survey data. All statistics were relatively consistent for the data set. Kendall's tau was selected for the analysis due to the small data set obtained from convenience sampling; the correlations are presented in Table 6.

A low-to-moderate (0.10–0.51) positive correlation was found between the pairs of the survey items on the use of the new CLSE system. Reflective question Item 5 had the lowest correlations. This can be expected due to variations in personal expectations and experiences and each individual's interpretation of these perceptions.

A significance test performed on the lowest correlation between Item 1 and Item 5 was significant ( $p < .001$ ). All correlations used the same sample size; consequently, all other pairwise correlations would also be statistically significant.

### Test for Cronbach Alpha

The Cronbach alpha test was performed on the data set. The test provides an estimate of how well the items measure the general construct. It is a function of the number of items, the average covariance between item-pairs, and the variance of the total scores. Generally the test result increases with increased intercorrelations between items. Cronbach's alpha of 0.7 to 0.8 is considered satisfactory for basic research. The R statistical software functionality for determining Cronbach's alpha also calculates test values for internal consistency: the interitem, item–total and corrected item–total correlations. The test results are presented in full in Appendix B.

**Table 3.** Kendall's Pairwise Correlations ( $n = 54$ ).

SAI Question	SAI Q1	SAI Q2	SAI Q3	SAI Q4	SAI Q5	SAI Q6
The screen for this software looks like other screens I have used.	1					
When I look at the icons and menus, etc., on the screen, I know what to use and how to use it.	0.387	1				
For the things that I use, this software looks and works the same way, every time.	0.293	0.468	1			
There is always enough information on the screen when it is needed.	0.439	0.469	0.404	1		
I think I will be able to use this software without asking for help from the experts who know how to use it.	0.118	0.209	0.472	0.483	1	
I would recommend this software to a colleague or friend.	0.333	0.483	0.492	0.499	0.514	1

*Note.* A significance test on the lowest correlation between SAI Q1 and SAI Q5 was significant ( $p < .001$ ). All correlations used the same sample size; consequently, all other pairwise correlations would also be statistically significant.

Cronbach's alpha is an estimate of how well the six items measure the computer experiential knowledge required to use the CLSE system. The Cronbach's alpha test result of 0.8 for the data is within the acceptable range.

Values of the overall alpha are calculated with each item not included in the calculation. In this case, these item values should not be greater than 0.8, which was Cronbach's alpha for the test. An item ranking greater than alpha should be dropped from the analysis to improve reliability. No items were greater than 0.8, indicating all items were retained for analysis.

If an item is less than 0.3, that item should not be retained, to improve reliability. Values above 0.5 indicate a strong internal consistency.

The average interitem correlation was 0.400. Interitem correlations are the average of all relevant pairwise correlations. No items were less than 0.3, indicating that all elements correlate well and are measuring a characteristic of a single construct.

The average corrected item-total correlation was 0.562. Item-total correlations are the correlations between each item and the total score for all responses for each case. Corrected item-total, or item-rest correlation, is the correlation of that item with the scale total if that item is not included in the total. The corrected item-total correlation for each case is greater than 0.3, indicating that all items correlate well with the overall scale.

Cronbach's alpha test results indicate that the internal integrity of the data set cannot be improved for quantitative data analysis by the removal of any items from the data set. Consequently, the survey data analysis results have a satisfactory level of correlation to indicate that the data consistently reports on the general concept under evaluation: intuitive use.

## Principal Factor Analysis

Principal factor analysis derives a mathematical model from the correlation matrix. The matrix eigenvalues associated with an item indicate the relative importance of the factors. A scree plot or the eigenvalues can locate the cutoff for selecting factors. Eigenvalues greater than one also help to indicate which factors are to be retained for further analysis. To calculate the degree that the items load on each factor, a technique called rotation is used to discriminate between factors.

Principal factor analysis was undertaken to reduce the data set into a smaller subset of measurement items and to apply that outcome to the findings as a descriptive method for the sample collected. A series of principal factor analyses were run to determine the number of factors for analysis and the interdependence of the factors. The final analysis is presented in Table 7.

The relatively small data set ( $n = 54$ ) was tested for suitability for factor analysis. In Test 1, the Bartlett-Sphericity test, the  $p$ -value of  $2.22e-16$  is less than 106.506, indicating it is unlikely that the observed correlation matrix was derived from a population with zero correlation. The data may provide meaningful analysis results.

Test 2, the Kaiser-Meyer-Olkin (KMO), which included Measures of Sampling Adequacy (MSA), is referred to in Table 8. The  $MSA > 0.5$ , therefore all elements can be included in the analysis. KMO-Criterion was 0.735. Test 3 was the Mod R test to ensure no items are very highly correlated (multicollinearity) and checks that the determinate of the correlation matrix  $> 0.0001$ . The determinate was 0.154. The Bartlett's Test result in conjunction with the KMO test result and Mod R indicate that the data can be used to perform a valid factor analysis.

**Table 7.** Principal Factor Analysis Results.

SAI Questions	Factor 1	Factor 2	Factor 3
SAI Q2	0.88		
SAI Q3	0.75		
SAI Q5		0.94	
SAI Q4		0.52	0.59
SAI Q6	0.45	0.47	
SAI Q1			0.91
<b>Eigenvalues</b>	1.72	1.64	1.34
<b>Proportion variance</b>	0.29	0.27	0.22
<b>Cumulative variance</b>	0.29	0.56	0.78
<b>Proportion explained</b>	0.37	0.35	0.28
<b>Cumulative proportion</b>	0.37	0.72	1.00

*Note.* Dominant Factor 1 accounted for 29% of the variance, Factor 2 accounted for 27%, and Factor 3 accounted for 22%. Together they account for 78% of the variance.

**Table 8.** All Measures of Sampling Adequacy for the SAI Questions Were Greater than 0.5 and Included in the Analysis.

SAI Q1	SAI Q2	SAI Q3	SAI Q4	SAI Q5	SAI Q6
0.7136030	0.7252974	0.780568	0.7630045	0.6260568	0.7839342

## The Factors

The interpretation of the factors is dependent on the items that load onto each factor. The questions with the highest loading dictate the character of the factor. The following names of the factors reflect this loading.

Factor 1–Familiar Use Expectations:

- SAI Q2 reflects effort expectancy and an expectation for clear and understandable control for ease of use;
- SAI Q3 reflects effort expectancy and pragmatic assessment of control for ease of use;
- SAI Q6 reflects ownership from positive user experience.

Factor 2–Confident Interaction Experiences:

- SAI Q5 reflects facilitating conditions and an expectation for self-efficacy with respect to control and usefulness;
- SAI Q4 reflects facilitating conditions and pragmatic assessment of control using screen artifacts;
- SAI Q6 reflects ownership from positive user experience.

Factor 3–Recognition of Prior Learning:

- SAI Q1 reflects visceral response to effort expectancy after observing the screen artifacts and layout;

- SAI Q4 reflects facilitating conditions and pragmatic assessment of control using screen artifacts.

Cronbach's alpha test provides a measure of the reliability of the factors for this survey. Factor 1 has Cronbach's alpha = 0.75, Factor 2 = 0.745, and Factor 3 = 0.67. The removal of any items from the factors would not improve their reliability.

The three factors—Familiar Use Expectations, Confident Interaction Experiences, and Recognition of Prior Learning—are all components identified in current research into intuition. Together they describe the internal consistency of the survey questions that characterize the general construct: intuitive design.

The survey data analysis results have a satisfactory level of correlation and factor extraction to indicate that the data consistently reports on the general concepts under evaluation. Consequently, the six items used for this evaluation as a subset of the SAI are considered suitable for evaluating intuitive design and intuitive use of software. Additional research to confirm this preliminary finding is recommended. However, based on the analysis presented, there is a reasonable basis for further use of the question set for the evaluation of software for intuitive design and use.

## CONCLUSIONS

The analysis of the survey in the case study resulted in an SAI Intuitive Use evaluation of 3.2. On a scale of 0 to 4, this result is indicative of a perception of a positive intuitive use experience. A factor analysis of the survey responses exposed three factors that described this intuitive use experience. The three factors in order of impact on intuitive use in the case study were called

1. Familiar User Expectations;
2. Confident Interactions;
3. Leverage of Prior Learning.

These factors replicate the theoretical elements of current research into intuition and are a one-on-one mapping of them onto the criteria for intuitive design and subsequent intuitive use. At this early stage, the survey has produced initial results confirming the proposed structure for analysis of intuitive design and intuitive use. This structure can assist further research into intuitive design and use.

The delivery of an experience of intuitive use can be evaluated by a survey of six questions that link the experience to an HCI framework of intuitive design criteria (see Table 9). This question set can be used by other researchers in the validation of their user interfaces and the results of the survey included in stakeholder return on investment reports.

In this paper I discussed current research findings into intuition and intuitive use and applied them to existing HCI design guidelines in a case study. There are two requirements for an experience of intuition: (a) existing experiential knowledge and skills in a particular domain, and (b) an unexplainable perception that a novel situation is contextually familiar. Extending intuition research into intuitive use adds the caveat of (c) successful application of previously acquired experiential knowledge and skills. The survey question set used in the case study assess the successful use caveat.

**Table 9.** Intuitive Design and Use Survey Questions Mapped to the HCI Design Criteria for Intuitive Interaction.

Questions to assess intuitive use	HCI Design Criteria
The screen for this software looks like other screens I have used.	Usability, distributed cognition, affordances
When I look at the icons and menus, etc., on the screen, I know what to use and how to use it.	Usability, distributed cognition, affordances
For the things that I use, this software looks and works the same way, every time.	Usability, distributed cognition, affordances
There is always enough information on the screen when it is needed.	Usability, distributed cognition, affordances
I think I will be able to use this software without asking for help from the experts who know how to use it.	Depth of immersion in the CoP
I would recommend this software to a colleague or friend.	Affirmation of software ownership and participation in the promotion of the CoP

To facilitate intuitive use, intuitive design has three overriding principles:

- present that which is already known and familiar in the domain;
- use familiar things to explain the use of unfamiliar things in this domain;
- provide consistent internal representation of all that is presented on the screens.

Intuitive use is the observable behaviors that are the direct result of the cognitive process called intuition that accesses previously acquired experiential knowledge and skills to commence and successfully complete a series of actions in a situation not previously encountered. Further research is necessary to confirm these early results.

## IMPLICATIONS FOR THEORY AND APPLICATION

This paper reported on action research that implemented current intuitive research tenants to design, implement and analyze a successful enterprise system. Software and in particular interface design is often considered more an art than a science. Current interface design practice, focused on intuitive design as discussed, is often implicit and the expertise built up over time. The research into intuitive design and use is ongoing. This papers contribution is to consolidate design practice and evaluation on a theoretical base that provides both research and industry practioners with an evidence-based theoretical reference point from which to commence their work. The use of the easily applied explicit guidelines for intuitive interface design presented in this paper can result in consistently relevant contextually designed user interfaces. Interfaces designed in this manner can improve the user experience and add to the research into intuitive use. In addition, the six-question survey is a system analysts' tool that can be used to assess any user interface for intuitive use and to confirm the appropriate application of the intuitive design guidelines.

## REFERENCES

- Bandura, A. (1978). The self system in reciprocal determinism. *American Psychologist*, 33, 344–358.
- Bandura, A. (1986). *Social foundations of thought and action*. Engle Cliffs, NJ, USA: Prentice Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY, USA: W. H. Freeman.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1–26.
- Blackler, A. (2006). *Intuitive interaction with complex artifacts* (Unpublished doctoral dissertation). Queensland University of Technology, Australia.
- Blackler, A. L., & Hurtienne, J. (2007). *Towards a unified view of intuitive interaction: Definitions, models and tools across the world*. Retrieved from <http://eprints.qut.edu.au/19116/>
- Blackler, A. L., & Popovic, V. (2015). Towards intuitive interaction theory. *Interacting with Computers*, 27(3), 203–209.
- Blackler, A. L., Popovic, V., & Mahar, D. P. (2009, September). *Concepts of intuitive interaction*. Paper presented at Workshop Tagung Mensch & Computer, Berlin, Germany.
- Bødker, S. (1991). *Through the interface: A human activity approach to user interface design*. Hillsdale, NJ, USA: Lawrence Erlbaum Associates.
- Buxton, B. (2010). *Natural user interfaces (NUI)*. Retrieved from <http://www.billbuxton.com>
- Carroll, J. (Ed.). (2003). *HCI models, theories and frameworks: Towards a multi-disciplinary science*. San Francisco, CA, USA: Elsevier Science.
- Carroll, J., & Rosson, M. (1987). Paradox of the active user. In J. Carroll (Ed.), *Interfacing thought: Cognitive aspects of human-computer interaction* (pp. 80–111). Cambridge, MA, USA: MIT Press.
- Checkland, P. (1999). *Systems thinking, systems practice – Includes A 30 Year Retrospective*. Chichester, UK: John Wiley and Sons.
- Embrey, D. (2015). *The skill, rule and knowledge based classification* [Monograph]. Retrieved from <http://www.humanreliability.com/articles/UnderstandingHumanBehaviourandError.pdf>
- Everitt, B. E., & Hothorn, T. (2010). *A handbook of statistical analysis using R* (2<sup>nd</sup> ed.). Boca Raton, FL, USA: CRC Press.
- Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. London, UK: SAGE Publications.
- Gibson, J. (1979). *The ecological approach to visual perception*. Boston, MA, USA: Houghton Mifflin.
- Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA, USA: MIT Press.
- Hutchins, E. (2000, May). Distributed cognition. In *The international encyclopedia of the social and behavioral sciences*. Retrieved from <http://eclectic.ss.uci.edu/~drwhite/Anthro179a/DistributedCognition.pdf>
- Kaptelinin, V. (2014). *Affordances and design*. Cambridge, MA, USA: The Interaction Design Foundation, MIT Press.
- Knowles, M. (1984). *The adult learner: A neglected species* (3<sup>rd</sup> ed.). Houston, TX, USA: Gulf.
- Lehane, P. (2008, November). *Usefulness emergent in the user experience: An empirical and theoretical analysis of technology acceptance in the workplace*. Paper presented at International Conference on Kansei Engineering and Affective Systems, Nagaoka, Japan.
- Lehane, P. (2010). Designing interactions for the collective user experience. In *Proceedings of the 22nd Conference of the Computer–Human Interaction Special Interest Group of Australia on Computer–Human Interaction*. New York, NY, USA: ACM. <https://doi.org/10.1145/1952222.1952247>
- Lehane, P. (2012a). *The system acceptance indicator: An analysis practice emergent from the plans, scripts and intuitive interaction of the collective user community* (Unpublished doctoral dissertation). University of South Australia, Australia.



- Lehane, P. (2012b). Make it intuitive: An evaluation of interaction design using plans and scripts from the computer-community of practice. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*, 8(1), 77–103.
- Lehane, P. (2012c). Mapping the user experience: Development of a validated instrument from the plans and scripts of the computer community of practice. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*, 8(2), 158–179.
- Lehane, P., & Huf, S. (2007, August). *Re-establishing user perception norms: How long does it really take*. Paper presented at European Conference of Cognitive Ergonomics, London, England.
- MacCallum, R., Widaman, K., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods*, 4(1), 84–99.
- Nardi, B. (Ed.). (1996). *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, MA, USA: MIT Press.
- Nielsen, J. (1993). *Usability engineering*. San Diego, CA, USA: Morgan Kaufman.
- Norman, D. (1988). *The design of everyday things*. New York, NY, USA: Doubleday.
- Norman, D. (2004). *Emotional design: Why we love (or hate) everyday things*. New York, NY, USA: Basic Books.
- Norman, D. (2010). Natural user interfaces are not natural. *ACM Interactions*, 17(3), 6–9.
- Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: What can be done? *Assessment & Evaluation in Higher Education*, 3(3), 301–314.
- O'Brien, M. A., Rogers, W., & Fisk, A. D. (2010). Understanding the role of experience in younger and older adults' interactions with a novel technology. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 54(20), 1827–1831. <https://doi.org/10.1177/154193121005402018>
- Preece, J., Rogers, Y., & Sharp, H. (2007). *Interaction design: Beyond human-computer interaction* (2<sup>nd</sup> ed.). New York, NY, USA: Wiley.
- Rasmussen, J. (1994). *Cognitive systems engineering*. New York, NY, USA: John Wiley & Sons Inc.
- Rogers, A. (2002). *Teaching adults* (3<sup>rd</sup> ed.). Philadelphia, PA, USA: Open University Press.
- Shneiderman, B. (1983). Direct manipulation: A step beyond programming languages. In Y. Vassilioun (Ed.), *Human factors in interactive computer systems* (pp. 57–69). Norwood, NJ, USA: Ablex Publishing.
- Shneiderman, B., & Plaisant, C. (2010). *Designing the user interface: Strategies for effective human-computer interaction* (5<sup>th</sup> ed.). Reading, MA, USA: Addison-Wesley Publ. Co.
- Suchman, L. (1987). *Plans and situated actions*. Cambridge, MA, USA: Cambridge University Press.
- Sweller, J. P., Ayres, P., & Kalyuga, S. (2011). *Explorations in the learning sciences, instructional systems and performance technologies, cognitive load theory*. London, UK: Springer Science + Business Media.
- Venkatesh, V., Morris, M., Davis, G., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Vicente, K. (1999). *Cognitive work analysis*. Mahwah, NJ, USA: Lawrence Erlbaum Associates Inc.
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA, USA: Harvard University Press.
- Winston, R. (1970, August). *Managing the development of large software systems*. Paper presented at IEEE WESCON/1970, Los Angeles, CA, USA.
- Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in Quantitative Methods for Psychology*, 9(2), 79–94.

---

## Author's Note

All correspondence should be addressed to  
Patrick Lehane  
University of Southern Queensland  
P. O. Box 32 Darling Heights  
Queensland, Australia, 4350  
patlehane101@gmail.com

---

*Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*  
ISSN 1795-6889  
[www.humantechnology.jyu.fi](http://www.humantechnology.jyu.fi)

## APPENDIX A

Descriptors for experience with course-level evaluation assess the familiarity of the academic staff with course-level evaluation per se, any experience with the university's process, and finally if a staff member has developed or researched course-level evaluation.

None: New to academia with no exposure to course-level valuation as someone being evaluated.

Limited: Know of but have no practical experience with course-level evaluation beyond my role as a lecturer.

Moderate: Understand the concepts and methodologies of course-level evaluation, may have carried out own course-level evaluations, have participated in previous course evaluations at the university or another university in my capacity as lecturer or course examiner.

Considerable: Applied analysis derived interventions in the practice of course-level evaluation based on previous course evaluation instruments, may have established course-level evaluation methodologies.

Extensive: Researcher with publications on course-level evaluation.

Descriptors to rate IT skills that relate to basic use and overall familiarity with university supported software that staff are expected to use on a day to day basis.

Beginner: I am learning to use basic programs such as Word and Excel, and I seldom use the Internet or e-mail.

Novice: I use email and the Internet regularly and I have a basic understanding of programs such as Word and Excel.

Proficient: I am an experienced user of email and the Internet and I regularly use programs such as Word, Excel and/or discipline-specific software.

Expert: I can customize an operating system and produce complex documents and presentations in appropriate programs, e.g., Word, Excel, and PowerPoint. Where applicable, I use discipline-specific software to a professional level.

## APPENDIX B

Cronbach's alpha test is a measure used to assess the internal consistency, that is, the reliability of a set of test data. It is calculated by correlating the score for each individual survey response with the total score for each observation and then comparing that to the variance for all individual item scores.

The overall  $\alpha$  for the test is the raw\_alpha value of 0.79 with a mean of 3.9 and a standard deviation of 0.46. In Table B1, each row in the reliability if an item is dropped section refers to an SAI question and its associated raw\_alpha. If any of the raw\_alpha values are greater than the overall  $\alpha$  of 0.79, dropping that particular item will increase the overall reliability of the data set analyzed. The result for X29.1 (SAI Question 1) is in the questionable range but was retained because other test results indicated that dropping it would not improve the reliability of the data set. The other columns of this section of the table refer to how the other statistics will change if that particular question is dropped/deleted.

In the item statistics section, if r.drop values are less than about 0.3, it means that particular item doesn't correlate very well with the scale overall and should be dropped from the data set. X29.1 has an r.drop value of 0.4 indicating it should be retained.

**Table B1.** Cronbach's Alpha Test for the SAI Intuitive Use Question Set.

```

Reliability analysis
Call: psych::alpha(x = MyopinionHCI6.noNa, keys = c(1, 1, 1, 1, 1,
1))

raw_alpha std.alpha G6(smc) average_r S/N ase mean sd
0.79      0.8      0.81      0.39 3.9 0.04 3.9 0.46

lower alpha upper      95% confidence boundaries
0.71 0.79 0.87

Reliability if an item is dropped:
raw_alpha std.alpha G6(smc) average_r S/N alpha se
X29.1      0.80      0.80      0.79      0.45 4.0 0.040
X29.2      0.75      0.76      0.75      0.38 3.1 0.049
X29.3      0.76      0.76      0.77      0.39 3.2 0.046
X29.4      0.74      0.74      0.75      0.37 2.9 0.052
X29.5      0.78      0.79      0.76      0.42 3.7 0.045
X29.6      0.73      0.73      0.74      0.35 2.7 0.055

Item statistics
n raw.r std.r r.cor r.drop mean sd
X29.1 57 0.59 0.58 0.46 0.40 3.8 0.67
X29.2 57 0.72 0.73 0.67 0.60 4.0 0.55
X29.3 57 0.68 0.71 0.62 0.54 4.0 0.58
X29.4 57 0.78 0.77 0.72 0.64 3.9 0.72
X29.5 57 0.61 0.64 0.56 0.48 4.2 0.50
X29.6 57 0.82 0.80 0.77 0.67 3.7 0.86

Non missing response frequency for each item
      2      3      4      5 miss
X29.1 0.05 0.19 0.67 0.09 0
X29.2 0.00 0.16 0.70 0.14 0
X29.3 0.02 0.12 0.72 0.14 0
X29.4 0.05 0.18 0.63 0.14 0
X29.5 0.00 0.05 0.72 0.23 0
X29.6 0.07 0.33 0.40 0.19 0

```