

**Description of novelty, novelty of description:  
A dialectic analysis of a Web-based course**

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## Abstract

This article proposes a theoretical framework for the identification and classification of the various processes that constitute Web-based education. The framework is based on the following premises: (1) Education may be regarded as a *corrective process*, since it is aimed at bringing about a desired change in students' knowledge and skills. (2) *Failures* in corrective processes (technical problems that prevent the dissemination of information, for instance) necessitate *higher-order corrections* (such as technical interventions). (3) Higher-order corrections might also be subject to failure. The recursive application of Premises (2) and (3) yields an *open-ended, dialectic hierarchy* of corrections and failures. The utility of this framework is demonstrated with a qualitative analysis of focus groups attended by students enrolled in an online Psychology course at the University of Pretoria. The analysis suggests that the problems associated with Web-based education might actually *contribute to its effectiveness* by instigating intrinsically valuable higher-order corrections, such as the cultivation of students' problem-solving skills.

## Keywords

Computer-mediated communication; Distance education and telelearning; Evaluation of CAL systems; Post-secondary education; Teaching/learning strategies.

## Introduction

It may be argued that science has two fundamental tasks: to describe new, previously unknown phenomena, and to find new ways of describing familiar phenomena. Branches of learning may be distinguished from one another in terms of the relative importance of these two tasks. For some – like astronomy, which peers ever further into space – the emphasis is on *description of novelty*. The challenge facing these sciences is to push back the frontiers of the unseen as far as current technological and theoretical constraints allow. For others – like psychopathology, which deals mostly with behavioral disorders that have been part of human experience since the dawn of history – the emphasis is on *novelty of description*. Their challenge is to find new ways of discerning patterns amid complexity and uncovering hidden relationships between variables.

The study of the psychosocial dimension of Web-based education finds itself in the precarious situation of having to accomplish *both these tasks simultaneously*. The proliferation of theoretical paradigms in the social and educational sciences attests to the fact that these disciplines, unlike many of the natural sciences, are still struggling to develop a truly adequate set of descriptive tools appropriate for their subject matter. As Jonassen, Hennon, Ondrusek, Samouilova, Spaulding, Yueh *et al.* (1997, p. 28) put it, “We are ill-equipped to adequately describe human thinking, let alone regulate it.” Studying learning and teaching in that most prosaic of settings – the classroom – is therefore already beset by numerous difficulties. Studying learning and teaching in an environment that did not even exist until a few years ago is like mapping virgin territory and developing the principles of cartography at the same time.

### ***New tools for new tasks***

Many studies of Web-based education reflect a determination to take up this dual challenge. Lee (2001), for instance, has proposed a model describing divergent styles that students might utilize to adapt to a Web-based learning environment, while Chan, Hue, Chou and Tzeng (2001) have developed a typology of the various ways in which the Internet may be integrated with education.

These models might be regarded as *taxonomic*, since they proceed by characterization and classification. Seels (1997) has compiled an extensive list of taxonomic models pertaining to instructional technology.

Other models are *evolutionary* in nature, as they incorporate time as a variable in their descriptive schemes. Mooij and Smeets (2001), for example, have developed a five-phase model depicting the gradual transformation of secondary school education through information and communication technology, while a model proposed by Bannan-Ritland, Harvey and Milheim (1998) depicts six stages in the development of Web-based instruction, ranging from simple information delivery to immersive collaborative environments. Bonk, Cummings, Hara, Fischler and Lee (2000) have punctuated the integration of Web technology with Educational Psychology courses into ten phases.

Evolutionary models often go by the name of “hierarchies”: the entity under consideration is envisaged as progressing through successive layers of complexity or sophistication as time passes. Some models, however, are hierarchic in the stricter sense that they denote, not a chronological succession of stages, but a distinction between various *levels of abstraction*. In such models, elements at each level of a hierarchy form a substrate for, or constitute a more fine-grained description of, elements at the next. According to Cloete (2001), for instance, an electronic education system consists of four layers: physical hardware and software, an electronic paradigm, educational middleware, and the process of instruction. Chan *et al.* (2001) have developed a similar model, while Mooij and Smeets (2001) have constructed a more extended hierarchy that includes interpersonal, departmental, organizational, regional, national and international considerations.

### ***Scope and objectives of this article***

The common denominator of the aforementioned studies is that they do more than add to the existing body of knowledge concerning computer-mediated instruction, cyber-communication, virtual classroom dynamics and acceptance of technological innovation; they propose novel frameworks in terms of which researchers might organize their data and present their findings. The present article

follows in this tradition. Its first half is devoted to the development of a framework for classifying and characterizing the myriad psychological, social, and technological processes that constitute Web-based learning and teaching. As the following pages will reveal, this framework is *evolutionary* in that it is concerned with changes occurring in a learning-teaching system over time. It is also *hierarchic* in that it categorizes these changes in terms of their relative order of abstraction.

Although inspired by the writings of anthropologist and theorist Gregory Bateson (1979, 2000/1972) – who, in turn, drew his inspiration from the mathematical work of Russell and Whitehead – it is neither a mathematical model nor a simple reiteration of Batesonian concepts. Like the scheme that Bateson developed for distinguishing various types of learning and communication, it is suited for the analysis of data that resists quantification. Unlike Bateson’s model, which takes *description* as its primary aim, it is explicitly geared towards *comparison* and *evaluation*.

This framework may be regarded as a new “lens” that researchers might use to study the firmament of Web-based courses. In the second half of the article, the authors demonstrate the utility of this lens by aiming it at a small, but hitherto uncharted, star in that firmament. The characterization of the course in question proceeds by repeatedly contrasting it with traditional, face-to-face instruction, and culminates in a comparison between the two systems in terms of overall effectiveness.

## Theoretical framework

It was pointed out above that education involves a diverse set of activities and processes. The first step towards the development of a theoretical framework will be to ascertain what these various processes *have in common* and how they *differ* from one another. For illustrative purposes, we will focus on three broad categories of processes that are central to education: *learning*, *intentional behavior*, and *communication*.

The common denominator of these three categories is that they may be described as *corrections*; what distinguishes them from one another is the *locus* of the corrections that they entail. Whenever I learn

something, the degree of correspondence between the ideas I have in my head and some aspect of the world around me is increased. One can say that learning effects a correction of my beliefs with regard to “reality.” During intentional behavior, the correction works in the opposite direction: a purposeful action (if it is successful) changes some external state of affairs so that it conforms to the ideas I have in my head about how things should be.

During communication, the “external reality” of one person corresponds to the inside of another person’s head. If I communicate information to you, for instance, my action is intentional in that it is meant to affect a change in what you know or believe. If you interpret my message correctly, on the other hand, you will have learnt something; the correspondence between my knowledge and yours will have increased.

### ***Orders of correction and failure***

A correction, then, can be classified in terms of whether it involves an imprint of the world upon a person, of a person upon the world, or of one person upon another. But corrections can also be classified in other ways. First, specific instances of correction can be compared with one another in terms of their relative success. Stopping at a red traffic light is a successful correction of a vehicle’s speed in accordance with traffic laws; stopping halfway into the intersection is an example of a less successful correction.

If a correction is partially or completely unsuccessful, it follows that the *processes* or *mechanisms* underlying that correction are themselves in need of correction. (If I cannot stop fast enough at a traffic light, for instance, it might mean that my vehicle is in need of new brake pads.) This line of reasoning paves the way for yet another classification scheme. For if we are willing to entertain the notion that the mechanisms responsible for one class of corrections might be subject to a *second* class of corrections, we must admit the possibility that this second class of corrections, too, might be ineffective in some way. (If I am ignorant of matters mechanical, for instance, I might fail to recognize my vehicle’s inability to stop in time as a symptom of worn brake pads. Hence, I might fail

to make the necessary replacements.) This implies the possibility of a third class of corrections acting upon the mechanisms of the second (increasing my knowledge of mechanics, for example), of a fourth acting on the third, and so on.

The type of argument applied in the previous paragraph is most aptly described by the term **recursion**. As Hofstadter (1979, p. 127) has pointed out, recursion is exemplified by “stories inside stories, movies inside movies,” pictures of pictures – or, in our case, corrections of corrections. A well-known example of recursion is the Fibonacci series

$$1, 1, 2, 3, 5, 8, 13, 21, \dots$$

in which the values of the first two terms are given, and every subsequent term is recursively defined as the sum of its two predecessors. The analogy with our typology of corrections is clear: once one has selected or defined a particular category of corrections and identified the failures to which it is prone, every subsequent category of corrections can be defined as *actions or processes aimed at reducing or preventing failures in the category preceding it*.

Combining or superimposing the two classification schemes discussed above yields an *open-ended, alternating or dialectic hierarchy* consisting of:

- **First-order corrections** (processes or events that bring about intrinsically desirable states of affairs);
- **First-order failures** (first-order corrections that have gone awry or miss the mark in some way);
- **Second-order corrections** (changes in first-order corrective processes that serve to prevent or reduce the incidence of first-order failures);
- **Second-order failures**; and so forth.

This dialectic is diagrammatically represented in Figure 1 and illustrated by means of the auto-mechanical example employed above. The examples are intended to emphasize the point that the hierarchy denotes neither a temporal sequence nor an ordering in terms of relative importance. The only essential difference between higher- and lower-order corrections is their relative *level of abstraction*.

### ***Orders of correction in learning, intentional behavior, and communication***

Are learning, intentional behavior, and communication organized in such a hierarchic manner?

Bateson spent the greater part of his scientific career arguing that this is indeed the case. During his early anthropological work, he coined the term *deutero-learning* to denote the process of “learning to learn,” or of becoming more adept at solving particular classes of problems. (A person who completes a series of rote learning tasks and consequently becomes more skilled at rote learning has undergone deutero-learning.) He also postulated the existence of a third order of learning – that is, learning which effects a change in a person’s ability to achieve deutero-learning.

Intentional behavior, too, can be described in terms of a hierarchy of corrections. Practicing my golf swing may be regarded as an example of a second-order correction, since it corrects the way in which I effect corrections in the ball’s position. Furthermore, if I find that my game still does not improve despite regular practice, I might decide to adopt a more effective *practice strategy*. This strategic correction would be an example of a third-order correction – a correction of a second-order corrective process.

Note that *learning* can sometimes stand in service of intentional behavior as a higher-order correction. The success of an action depends, not only on skill, but also on the correctness of the doer’s belief regarding the probable result of that action. Hence, if that belief is mistaken, it will need to be corrected – and the correction of beliefs is typically achieved through learning.



Perhaps the clearest examples of the hierarchic organization of human experience can be gleaned from the realm of communication. Saying that a person interpreted a given event or signal as a *message* implies that that person had some (conscious or unconscious) prior belief as to the *meaning* of that event or signal. Note that this belief belongs to a higher level of abstraction (or, to use the terminology that Bateson borrowed from Russell and Whitehead, a higher *logical type*) than the belief being corrected through receipt of the message. Your telling me that the wolf is at the door, for example, may change my belief regarding the position of the wolf, but it does nothing to alter my conviction that the word “wolf” stands for a dangerous predator that frequently appears in fairy tales.

If communication depends on communicators’ beliefs regarding the meanings of the messages being exchanged, it follows that these beliefs might, in some instances, be mistaken. A person might misinterpret a signal or be ignorant as to its significance. (I might, for instance, construe your statement regarding the wolf as a literal report when, in fact, you intended it metaphorically.)

Avoiding or counteracting errors of this kind necessitates another kind of communication: communication about the *meanings* of messages. Bateson dubbed communication of this kind **metacommunication**, or the exchange of **metamessages**. In terms of the framework developed above, metacommunication may be regarded as a species of *second-order correction*: it corrects the manner in which communication effects corrections in a person’s beliefs.

The success of metacommunication depends, of course, on communicators’ ability to understand one another’s metamessages. Hence, metacommunication might also be subject to failure or misinterpretation, and the correction of such errors calls for *third-order corrections*, or “meta-metacommunication”. In principle, such a hierarchy might be extended *ad infinitum*; in practice, however, it probably reaches a genetically determined ceiling after a finite number of levels. It is likely, for instance, that human beings are born with innate beliefs (or knowledge) regarding the meanings of certain gestures, facial expressions, etc. Without it, learning one’s mother tongue would be an impossible task. Yet, labeling a given item of knowledge as “genetically determined” does not

remove it from the realm of communication. For what are genes, if not an elaborate system of messages by which biological information is transmitted from one generation to the next?

### ***Categories of difference in hierarchic corrective systems***

If two similar corrective hierarchies comprising learning, intentional behavior, and/or communication are placed side by side, what kinds of difference might one expect to find between them? The relevance of this question derives from the eventual aim of this discussion, which is to develop a framework for comparing traditional and computer-mediated learning and teaching. Three general statements can be made regarding such comparisons.

First, the two systems might differ at each level in terms of the *types* of corrections that need to be carried out (in other words, they might differ in terms of **necessary corrections**). Even if two systems are identical in terms of necessary corrections, however, they might still differ in terms of the *manner* in which these corrections are achieved (that is, they might differ in terms of **corrective processes**). Suppose, as a very simple example, that you and I were both required to memorize a list of words. If your list differed from mine, this would entail a difference in *necessary first-order corrections*, since the information that you had to assimilate would differ from the information set before me. Even if our lists were identical, however, you and I might still employ different *processes* of memorization: I might rely on simple rote learning, while you might choose a strategy based on mnemonic association or insight into the *meaning* of the list.

Second, differences in *failures* at each level are related to differences in corrections at that level: some failures might be the result of differences in necessary corrections, while others might arise from differences in corrective processes. Suppose, for example, that you are able to memorize your list, while I am unable to memorize mine. If both of us were using the same first-order corrective process (the same memorization strategy), a likely cause of this difference in first-order failure would be a difference in *necessary first-order correction*. It might be, for instance, that my list is five times as

long as yours. If, on the other hand, our lists were identical, a plausible explanation would be a difference in first-order corrective *processes*, or in our respective memorization strategies.

Third, a difference in terms of a *necessary higher-order correction* inevitably stems from a difference in *failure* at the level directly below it, while a difference in a higher-order corrective *process* might occur even in cases where all subordinate levels are identical. In terms of the aforementioned example, a second-order correction would be a change from a less to a more effective memorization strategy. If you are able to complete the memorization task, while I am not, it would follow that I am *in need* of such a second-order correction, while you are not. But even if you and I needed equally to improve our memorization strategies, we might still go about it in different *ways*. You might deliberately try out various strategies until you find one that works, for example, while I might spontaneously and without reflection drift from one strategy to another.

### ***Intrinsically and extrinsically necessary corrections***

A first-order correction was defined above as a process or event that brings about an intrinsically desirable state of affairs. (Note, in passing, that the *criteria* for regarding a state as “desirable” were left unspecified; these might involve biological or economic survival, or the subjective preferences of the observer). A higher-order correction, on the other hand, was defined as a change in the mechanisms or parameters of a corrective process occupying the level directly below it, so as to increase the latter’s probability of success. This definition requires some qualification.

It is possible to find many examples of higher-order corrections whose products are desirable for reasons *other* than their effects on lower-order corrective mechanisms or on the incidence of lower-order failures. Hence, while all higher-order corrections are **extrinsically necessary** (by virtue of their direct or indirect effects on first-order corrections) some are also **intrinsically necessary**. An engineer designing a bridge, for example, is unlikely to succeed without adequate knowledge of the laws of physics. Increasing this knowledge may therefore be regarded as an *extrinsically necessary second-order correction*; it improves the probability of successfully attaining a necessary *first-order*

*correction* (drawing up a viable plan). But, from a scientific or academic point of view, increasing one's knowledge of physical laws is also a valuable end in itself – that is, it is also intrinsically necessary.

Thus far we have identified two categories of higher-order corrections: those that are extrinsically necessary but intrinsically neutral, and those that have extrinsic as well as intrinsic value. It is possible to add a third class: one comprising cases of extrinsically necessary higher-order corrections that are intrinsically *undesirable* – or, conversely, of intrinsically necessary higher-order corrections that have as an inevitable correlate an *increase* in the incidence of lower-order failures. The idea that conflict or incongruence might exist between intrinsically and extrinsically necessary higher-order corrections forms the basis of Bateson's well-known *double bind hypothesis*.

A classical example of a double bind is the experience of being punished for holding *accurate* beliefs regarding the meanings of certain messages or the likely outcomes of certain actions (Perold, 2001). Correcting such beliefs is extrinsically necessary because it is an essential prerequisite for successful communication or the attainment of desired goals. But, if one is punished for doing so, it is also intrinsically *undesirable*. A person caught in a double bind is therefore forced to choose between *doing the wrong thing* (that is, failing to achieve a first-order correction) or else *doing the right thing for the wrong reason or in the wrong way* (that is, successfully achieving the first-order correction, but by means of a process that is for some or other reason undesirable, and therefore stands in need of second-order correction).

### ***A paradigm for education***

Only one step remains in the development of our theoretical framework, and that is to *anchor* the hierarchy of corrections. (Recall that, in the case of the Fibonacci series, defining a term as the sum of its two predecessors is meaningful only if the values of the first two terms have been given.) This step comprises two tasks. The first is to decide which outcomes within the educational context merit the term “necessary first-order corrections” (by virtue of their being the primary goals of education)

and which actions or events merit the term “first-order corrective processes” (by being the primary *means* through which these goals are attained). The second is to specify what might count as “failures in first-order corrections” (in other words, factors or events that might hinder the attainment of primary educational goals). These two tasks will be attempted below.

One of the basic aims of education is to equip learners with certain knowledge and skills. Exactly what they have to know and be able to do upon completion of an educational program is often formally specified in terms of *learning outcomes*. Another important goal of education is to provide society (through the agency of educators) with convincing proof that learners have acquired the stipulated knowledge and skills. What kind of evidence is to be regarded as “convincing” is also often officially stated, in the form of *assessment criteria*. **Necessary first-order corrections** in the context of education may therefore be defined as (a) the attainment of learning outcomes on the part of learners and (b) the fulfillment of assessment criteria on the part of teachers. These are the corrections that need to be attained for learning and teaching to be considered effective.

**First-order corrective processes**, on the other hand, may be defined as sequences of behavior or interaction whose direct result is to further either of the two goals identified above. In other words, a first-order correction can be said to have taken place if:

- Educators have disseminated information pertaining to learning content to students, and students have received, assimilated and retained this information;
- Students have acquired knowledge relevant to learning outcomes through independent exploration or discovery;
- Students have practiced what they have learnt so as to transform knowledge into skill; or
- Students have demonstrated what they have learnt, allowing educators to form an accurate impression of the extent to which learning outcomes have been achieved.

A moment's reflection will convince the reader that there are many ways in which such first-order corrective processes could go awry. Lecturers might, for instance, fail to provide students with the right information at the right time. Another possibility is that lecturers disseminate the necessary information, but that for some reason students do not receive it. Or the information might be received but not understood, or understood but not retained, or retained but not put into practice. Even if learning outcomes are attained, the possibility remains of assessment criteria not being met. Students might provide an inadequate demonstration of what they have learnt, or lecturers might form a biased impression of students' knowledge and skills. Any such mishap can be regarded as a **first-order failure** – that is, a discrepancy between necessary first-order corrections and those corrections that are actually carried out.

Once first-order corrections and their concomitant failures have been pinned down, all higher-order corrections and failures can be recursively defined. More specifically, a necessary  $N^{\text{th}}$ -order correction is a correction that needs to be carried out so as to avoid or counteract failures in corrections of order  $(N - 1)$ . By the same token, an  $N^{\text{th}}$ -order corrective *process* is any sequence of behavior or interaction whose direct result is to achieve a necessary  $N^{\text{th}}$ -order correction.

As was discussed above, a comparison between two sets of hierarchically organized corrective systems may reveal four dimensions of difference at each level: differences in necessary corrections, in corrective processes, in failures arising from differences in necessary corrections, and in failures arising from differences in corrective processes. Once a hierarchic description of learning and teaching has been achieved, computer-mediated education can therefore be compared with its traditional counterpart by mapping the characteristic features of each onto these four dimensions. In the following sections, this mapping procedure is applied to a data set consisting of students' accounts of a course containing several Web-based components.

## Data collection

The M.A. (Research Psychology) course at the University of Pretoria, South Africa, is designed to supply the marketplace with professionals capable of amassing reliable information about the ways in which people experience and interact with their world, and of employing such information in the service of responsible and strategic decision-making. Most of its graduates find employment in market research companies, broadcasting corporations and HR management departments in the public and private sectors. The course consists of a directed component spanning one year, followed by a one-year internship under the supervision of a registered research psychologist at an accredited institution. Students are also required to complete a dissertation on a research topic of their choice. The yearly intake of the course averages around ten students.

The directed component of the course currently comprises fourteen modules, of which nine are partially or completely Web-based. These modules provide students with the opportunity to learn how to design and conduct quantitative and qualitative research, how to analyze quantitative data using SPSS (Statistical Package for the Social Sciences), and to apply their newly acquired skills in a variety of real-world contexts. Students are also expected to understand the theoretical and philosophical underpinnings of behavioral research.

In accordance with the University of Pretoria's policy on telematic education, WebCT is used as a vehicle for the dissemination of course-related information such as study guides and prescribed literature. Although WebCT also has its own e-mail and course administration facilities, the students and lecturers of the M.A. (Research Psychology) course tend to prefer using other commercially available packages (such as Microsoft Outlook and Excel) for these purposes. A more detailed description of WebCT can be found in Dabbagh and Schmitt (1998).

The decision to use this course as a testing ground for the theoretical framework was based on the fact that both authors are involved in its presentation. Two focus groups were conducted with students enrolled in the course. The first was held in 2000 at the end of the academic year and was attended by

nine students, six of whom were aged between 23 and 26 years, while the remainder varied between 33 and 43 years. Rating their level of familiarity with computers on a scale from 1 (Unfamiliar) to 5 (High), four members of this group chose 3 (Average), while the remainder were more or less evenly dispersed between 1 and 5. The correlation between age and familiarity with computers was calculated to be  $r = -0.44$ , which is not statistically significant. Two thirds of the group reported that they had very little or no prior online experience.

The second focus group involved a new class of seven students and was held early in 2001, about three months into the course. Five members of this group were aged between 23 and 28 years; the remaining two were aged 32 and 41, respectively. Three of them rated their familiarity with computers as “Average” (3); the rest were evenly dispersed between 1 and 5. This group disclosed no correlation between age and familiarity with computers, but those who gave themselves a less-than-average rating also reported having had very little or no prior online experience. Each group had only one male member. Both groups were asked to relate whatever came to mind with regard to their experiences of Web-based learning, and the ensuing conversations were recorded and subsequently transcribed.

In view of the fact that the stated aim of this article is to *compare* virtual and traditional education, a word of explanation is in order regarding the omission of a “control group” – a focus group with students who were *not* enrolled in a Web-based course – from the research design. Following Bateson (2000), we assume that every experience, and every statement about an experience, involves or implies a *contrast*. We see objects only insofar as they differ from their background, for example, and if I say “The course is difficult,” my statement implies a comparison between this course and others. In the same way, asking students to relate their experiences of Web-based learning effectively invites them to view this mode of learning against the backdrop of other methods that they have experienced. The comparison comes “built in,” so to speak, with the chosen research design.



## Data analysis

The first step in the analysis of the focus group data was to subdivide each transcript into “statements” – utterances or sections of dialogue pertaining to particular issues or themes. Second, all statements pertaining to *first-order corrections* or *first-order failures* were singled out. The recursive scheme described earlier was then applied to identify all statements referring to higher-order corrections and failures. Statements were further categorized in terms of whether they referred to *similarities* or *differences* between virtual and physical educational environments.

A few examples of transcribed statements, the categories to which they were assigned, and the reasoning underlying their classification are provided below:

- “Information was delivered at a very fast pace.” This statement was classified under *First-order corrections*, since it refers to the dissemination of course-related information.
- “When working alone, like, on an assignment, I often wonder: Am I doing this the right way? Did I miss something important?” This statement was classified under *First-order failures*, since it refers to the risk of misinterpreting course-related information.
- “In Statistics, in an ordinary lecture, it’s easy to put up your hand and ask the lecturer to explain some basic concept you don’t understand. In Web-based learning, you have to ask your questions by e-mail. The effectiveness of Web-based learning depends very much on how promptly lecturers respond to e-mail messages.” This statement was classified under *Second-order corrections*, since it refers to metacommunication (communication about the meanings of messages).
- “Doing a course on the Web is much more difficult, because it takes longer to get answers from lecturers. So you rely more on trial-and-error learning – but that takes even more time!

I sometimes felt very lonely and anxious in the course.” This statement was classified under *Second-order failures*, since it refers to a breakdown in metacommunication.

- “The course somehow develops a sort of ‘attitude’ – being at ease with technology, coping with stress, delivering presentations, working on our own ... That places us [the Research Psychology students] at an advantage compared to the clinical and counseling students.” This statement was classified under *Third-order corrections*, since it describes how some students overcame the difficulties posed by second-order failures.

Table 1 contains a breakdown of the two focus groups in terms of the number of statements sorting in each category. The figures depicted in this table reveal two general trends: there are more statements referring to *failures* than to *corrections*, and there are more statements referring to *lower-* than to *higher-*order corrections. Both these trends can be explained in terms of salience effects. First, people tend to be more aware of things that go wrong than of things that go right. Second, higher-order corrections tend to take place at a slower rate than lower-order corrections, making them less conspicuous.

As might be expected, the experiences recounted by the two groups of respondents revealed a considerable degree of consensus. (For instance, both groups identified technical problems and a lack of computer literacy as significant obstacles in Web-based learning.) A headcount of the number of statements in each focus group transcript that has an approximate semantic equivalent in the other yielded a figure of 41. Dividing this by 84 (the total number of statements recorded) places the proportion of overlap between the contents of the two focus groups at just under 50%.

The two focus groups also resembled each other in that neither contained any reference – except by vaguest insinuation – to processes or events more abstract than third-order corrections. It is likely that more comprehensive research – perhaps a longitudinal study of the course over a period of several years – would have expanded the data set into additional levels. The analysis presented below is therefore divided into five sections, each containing a discussion of respondents’ accounts relating to

a particular order of correction or failure. Where appropriate, supporting data gleaned from specialist literature is also cited. The key results of the analysis are presented in diagrammatic form in Figure 2.

### ***First-order corrections***

First-order corrections in the realm of education were defined above as (a) the cultivation of valuable knowledge and skills and (b) accurate, fair assessment of the extent to which this goal has been achieved. Differences in necessary first-order corrections therefore entail differences in *learning outcomes* (resulting from curricular changes, for instance) or in *assessment criteria* (due, perhaps, to a change from content-based to outcomes-based assessment). Since the aim of this study is not to compare the M.A. (Research Psychology) course with other courses in terms of its *goals*, but in terms of how these goals are *achieved*, respondents' statements pertaining to first-order corrections were limited to a comparison between the two environments in terms of first-order corrective *processes*.

### **Similarities between physical and virtual educational environments**

Similarities between the two environments in terms of first-order corrective processes mostly involve the *cognitive* dimension of learning and teaching – in other words, that which happens inside people's heads. Students in either environment spend a good deal of their time reading, thinking, and digesting information. Another important solitary activity is the acquisition of skills through practice. Respondents made particular mention of the many hours they spent rehearsing statistical procedures on their computers.

### **Differences in corrective processes**

Differences between the two environments in terms of first-order corrective processes mostly involve the *interactional* dimension of learning and teaching – in other words, that which happens *between* people. In a physical environment, such interaction usually takes the shape of lectures, class discussions, group work, and the demonstration of learning by means of practical assignments or written tests and examinations. Face-to-face interpersonal communication therefore forms an

important component of education in a physical environment, and the distinctive feature of such communication is the fact that it is *synchronous* and *rapidly paced*.

Interaction in a virtual environment, by contrast, is mostly *asynchronous* and more *leisurely paced*. Instead of lectures, the World-Wide Web is often used to disseminate course content to students, and a large proportion of the communication among students or between students and lecturers takes place via e-mail. In the place of paper-based tests and examinations, assessment is often accomplished by means of assignments that students have to complete in their own time and submit via e-mail.

### ***First-order failures***

First-order failures in education were defined above as any factors that prevent the fulfillment of learning outcomes or assessment criteria. Differences between physical and virtual environments in terms of first-order failures might, in principle, arise from differences in corrective processes or from differences in necessary corrections. Since the previous section did not contain any reference to differences in necessary first-order corrections, however, the analysis below is limited to *similarities* and to differences in corrective *processes*.

It is interesting to note that all instances of first-order failures cited by the respondents pertain to the *interactional* dimension of learning and teaching, and none to its *cognitive* dimension. (A likely candidate for the latter would be ineffective study methods.) This omission is perhaps not surprising, given the fact that the expressed aim of the focus groups was to assess students' experiences of their education *environment*, and not of their own academic strengths and weaknesses.

### **Similarities in failures**

Respondents mentioned two types of first-order failures that they experienced during the course, but that might just as well have occurred in a physical environment. The first involved poor planning on the part of lecturers. Students were sometimes given short notice of due dates of assignments; learning activities were sometimes ordered in an inappropriate manner, so that students were

presented with information long before being given the opportunity to apply it; and learning content was sometimes unnecessarily repeated in different modules.

The second failure involved what is probably the most common of students' complaints: "I don't understand." As Hara and Kling (2001) have pointed out, much of human communication is inherently ambiguous – and this ambiguity is inevitably exacerbated by unfamiliar or complex course content. The most frequent culprits in this regard were statistical theory and its practical application using the SPSS software package. Several respondents complained of having insufficient background knowledge to grasp the logic of the new statistical techniques they were expected to master, and of being unable to follow the instructions for implementing them on a computer. As will be revealed in later sections, this second category of failures has important higher-level repercussions in the hierarchy of corrections.

### **Differences in failures arising from differences in corrective processes**

The synchronous and intimate nature of face-to-face interaction can sometimes be a source of first-order failure in a physical educational environment. Students might, for instance, miss a lecture due to unforeseen circumstances or competing commitments, while introverted individuals might refrain from taking part in discussions because they feel intimidated by the physical presence of peers and lecturers (Bonk & Cummings, 1998; Cooney, 1998). The rapid pace of face-to-face interaction might also be a drawback: students might lose the thread of a lecture, or a lecturer might unintentionally omit important information.

A virtual educational environment is largely free of such errors. Thanks to the asynchronous nature of their interaction, students and lecturers are able to attend to messages at times that are convenient for them. (One cannot oversleep a Web-based lecture!) Communicators also have more time at their disposal to formulate and interpret messages (McIsaac & Gunawardena, 1996; Tiene, 2000).

Unfortunately, these strengths are to some extent offset by a number of weaknesses. Communication in a virtual environment is more likely to fail because of the electronic medium's inability to meet the

needs of communicators, or because of communicators' inability or reluctance to meet the demands imposed on them by the medium.

### **Limitations of the medium**

A large proportion of each focus group was devoted to the woes of modem breakdowns, hard drive crashes, computer viruses and network failures that prevented students from accessing Web-based course material and meeting deadlines. Respondents also complained that scanned documents were sometimes poorly legible, implicating the conversion of course content from paper-based to electronic format as a cause of failure. Technical problems impacting on the assessment process were a particular source of stress. In one incident, students' assignments that had been submitted as e-mailed attachments were corrupted at some stage during the transmission process, resulting in an unfair loss of marks.

Even if all these technical difficulties were ironed out, computer-mediated communication would still fall short of its face-to-face counterpart in some respects. Respondents pointed out that e-mail is simply too slow for certain communicative purposes, such as organizing meetings and allocating tasks for group assignments. Face-to-face or telephonic communication turned out to be much more appropriate for such undertakings. These shortcomings of the virtual medium have also been pointed out by a number of other authors, including Hara and Kling (2001), Lieblein (2000) and Tiene (2000).

### **Limitations of communicators**

Many failures in communication were the result of deficiencies in students' and lecturers' *computing skills*. Several respondents mentioned that they were hampered by slow typing speeds and by the fact that course-related information was sometimes placed on the Web in the form of compressed documents which they did not know how to decompress. Similar findings regarding the importance of computer literacy have been reported by Soong, Chan, Chua and Loh (2001), and by Wu and Lee (1999). Inadequate knowledge of Web page design principles on the part of lecturers or technical

support personnel was also sometimes at fault: respondents mentioned instances in which important information was hidden in inconspicuous places on the Web, thereby increasing the probability of its being overlooked.

Lack of knowledge was not the only obstacle impeding communication. Some respondents mentioned that their *motivation to communicate* was negatively affected by the relatively impersonal nature of computer-mediated interaction – an effect previously reported by Abrahamson (1998), Brown (1996), and others. During the discussion, it was remarked that a few lecturers also seemed to be afflicted by this condition, since they tended to restrict Web-based interaction with students to an absolute minimum. An alternative explanation of lecturers' reluctance to utilize computer-mediated communication is that they are unwilling to abandon tried and proven instructional models in favor of new ones (Van Braak, 2001).

Other obstacles involved *physiological* and *financial* constraints. Some students found it physically uncomfortable to read large volumes of text directly off the monitor. They preferred printing out documents before perusing them – but this involved increased expenditure in terms of printer cartridges and paper. The cost of spending long periods of time online (in South Africa, users are charged for local telephone calls) also limited some students in terms of the amount of information they could download from the Web.

In sum, the respondents devoted much more time to discussing the relative *demerits* of computer-mediated communication than to discussing its merits. This disparity implies that, as far as communication is concerned, they experienced the virtual educational environment as more error-prone than its physical counterpart. In other words, they rated the two environments differently in terms of their susceptibility to problems that our classification scheme subsumes under “first-order failures.”

## ***Second-order corrections***

The most conspicuous first-order failures cited above involved (a) instances in which students were unable to understand or interpret course-related information, and (b) cases where a mismatch occurred between the needs and capabilities of communicators, on the one hand, and the potentialities and constraints of the medium, on the other. Candidates for second-order corrections would therefore be chains of events or messages that (a) increase the *knowledge* that communicators have at their disposal when formulating messages or interpreting the messages of others, or (b) increase the “goodness-of-fit” between communicators and medium. A few examples of such corrections are provided below.

## **Similarities between physical and virtual educational environments**

The respondents described two strategies that they frequently employed to rectify their interpretation of course content. The first involved *trail-and-error*. If a set of instructions for carrying out a statistical test on SPSS failed to yield the desired results, for instance, students would often attempt several alternative interpretations of the *same* set of instructions until one of them proved successful. Another strategy that was often employed in such situations involved turning to lecturers or peers for *clarification* of course-related information. Either of these strategies might, of course, be adopted in a physical or virtual educational environment.

The term “metacommunication” was introduced earlier to denote the exchange of message that comment on or correct the manner in which certain *other* messages are understood. If one considers the two examples of second-order corrections cited in the previous paragraph, it becomes evident that the second of these – eliciting and receiving clarifying messages from lecturers or fellow-students – may be regarded as an example of metacommunication. The applicability of this term derives from the fact that such sequences of communication are intended to *alter students’ interpretation of the information with which they were originally supplied*.



## Differences in corrective processes

Metacommunication is an essential component of all human communication, regardless of whether this communication occurs in a virtual or a physical environment. The *processes* by which metacommunication is most commonly effected in the two environments are, however, very different. In a physical environment, face-to-face interaction is accompanied by a more or less continuous stream of non-verbal, spontaneous – almost subliminal – metamessages. Speakers use tone of voice, facial expressions and body language to indicate how their words should be interpreted (whether, for instance, a statement is intended earnestly or in jest), as well as to ascertain whether their own messages have been understood correctly. Very often, communicators themselves are only marginally aware of the extent to which their communication is guided by such unspoken signals. A number of authors – such as McIsaac and Gunawardena (1996), Tiene (2000), and Vrasidas and McIsaac (2000) – have pointed out the central role that such non-verbal or paralinguistic metacommunication plays in determining the effectiveness of face-to-face instruction.

A virtual environment, by contrast, is what Garrison, Anderson and Archer (2000) describe as a “lean medium” – a medium stripped of the aforementioned metacommunicative channels. When students and lecturers communicate via e-mail, for instance, messages such as “This is a joke” or “I don’t understand” have to be (implicitly or explicitly) included in the e-mail text itself. This means that most of the automatic, spontaneous character of metacommunication is lost. Whereas, during face-to-face interaction, communication about the meaning or interpretation of messages can largely be entrusted to habit or instinct (indeed, the autonomy of non-verbal metacommunication is such that its *inhibition* often requires conscious effort and skill), communicators in a virtual environment have to *think* about their metacommunication.

*Intentional gestures* also have an important metacommunicative function in face-to-face interaction. As several respondents pointed out, a traditional tutorial or lecture context allows one to physically *point* to an item of information – a part of a statistical formula or a computer icon, for example – and ask, “What does this mean?” In a virtual environment, on the other hand, one would have to compile

an e-mail message that somehow incorporates the formula or a description of the icon along with one's question. The respondents also noted that such electronic "pointing" is necessarily much more time-consuming than its corporal counterpart. Their observations in this regard correspond to those of Bonk, Malikowski, Angeli, and East (1998), who noted that demonstrations and modeling are more difficult to perform on the Web than in a classroom.

The *physical context* in which communication takes place also often fulfils a metacommunicative role. This fact is exemplified by an incident that occurred in the M.A. (Research Psychology) course during a series of e-mail class discussions. About three weeks after the commencement of the discussions, one student sent a slightly disgruntled e-mail message declaring that he had already submitted two contributions, but had not as yet received any response from the lecturer. It transpired that this student had modeled his expectations of the e-mail class discussions on previous experiences of class *presentations*, during which the lecturer would typically acknowledge and respond to each student's contribution individually. Had the discussions been conducted in a physical instead of a virtual setting, this misunderstanding would have been avoided. At the start of the first discussion, the lecturer would probably have asked the students to seat themselves in a circle, and this arrangement would immediately have alerted them that a *conversation* – not a series of presentations – was to follow.

### **Differences in necessary corrections**

Differences between physical and virtual educational environments in terms of first-order failures give rise to differences in the *types* of second-order corrections that need to be carried out. In the discussion of first-order failures, it was pointed out that *technical difficulties* are a much more prevalent cause of communicative breakdown in a virtual than in a physical environment. Hence, maintaining channels of communication in the former requires more frequent second-order corrections in the form of technical interventions. Malfunctioning modems or inoperative networks need to be repaired or reconfigured, for instance, while e-mail messages that were corrupted during transmission have to be re-sent, perhaps by alternative means. While such corrections received little

mention during the focus groups, they must have occurred with some frequency – otherwise the learning and teaching process would have ground to a halt. Several respondents did, however, mention that they would have benefited greatly from a university-based technical support service. Such statements provide indirect support for the assertion that technical interventions were a frequent necessity.

The respondents did, however, single out two second-order corrections impacting upon other first-order failures unique to a virtual environment. One involved an increase in the *skill* with which they engaged in computer-mediated communication. This increase in communicative competence was attributed partly to a short course in basic computing skills offered near the beginning of the academic year, and partly to the gradual effect of continuous practice. The other correction involved what might be termed “*acclimatization*” to the virtual environment: some respondents mentioned that, as the year progressed, they became more and more comfortable reading course material directly off the computer monitor instead of first printing it out.

### ***Second-order failures***

In the previous section, two varieties of second-order corrections were identified that are common to physical and virtual environments and that effect changes in the manner in which messages are understood: *trial-and-error* and *metacommunication*. Three types of second-order corrections were also identified as being characteristic of a virtual environment: ironing out *technical problems*, improving communicators’ *computing skills*, and becoming accustomed to the *sensory strain* of computer-mediated communication. A second-order failure would be any factor or set of factors that prevents such corrections from being effected. The aim of this section is to point out similarities and differences between virtual and physical educational environments with regard to such failures.

### **Similarities in failures**

The respondents identified two reasons why *trial-and-error* might fail as a second-order corrective strategy. First, it is a slow, laborious process, and might require more time than students have at their

disposal. Second, a haphazard trial-and-error strategy might fail to converge on the correct solution, even if it is not subject to a time limit.

In contrast with trial-and-error, the success of *metacommunication* as a second-order correction depends on the readiness and capacity of others to provide clarifying information regarding the meanings of messages. Hence, a situation might arise in which some students demand more external assistance than lecturers or fellow-students are willing or able to provide. This second-order failure, like the failures in trial-and-error described above, might occur in a physical as well as in a virtual environment.

### **Differences in failures arising from differences in corrective processes**

The respondents also identified two varieties of failure that are peculiar to computer-mediated metacommunication. First, the fact that metacommunication in a virtual environment cannot be entrusted to habit or instinct means that it runs the risk of being *unintentionally omitted*. The respondents recounted several incidents in which such omissions were the cause of interpersonal misunderstandings. In one case, a jocular e-mail message directed at a fellow student produced some distress because it was interpreted as a criticism of that student's character. It transpired that the sender of the message had neglected to translate the metamessage "This is a joke" into electronic format to accompany her remarks concerning the other student.

Second, the *slow pace* of computer-mediated communication often makes it untenable as a metacommunicative strategy. Respondents provided vivid accounts of the frustration of having to meet assignment deadlines, and of being unable to do so because each e-mailed request for assistance required a turnaround time of several hours. This sometimes left them with no option but to engage in the arduous (and lonely) process of correcting their understanding of course content through trial-and-error. Lieblein (2000) has sketched a similar picture of students' exasperation, suggesting once again that the experiences of our participants were far from unique.

### **Differences in failures arising from differences in necessary corrections**

It was pointed out earlier that communication in a virtual environment is more labile than communication in a physical environment, and hence requires more frequent second-order corrections. It is conceivable that any such second-order correction might go awry. There might, for instance, be insufficient backup systems in place to deal with technical difficulties in a Web-based course. As was mentioned above, some respondents did, in fact, lament the absence of a “technical help-desk” to assist students in such matters, and Alexander, McKenzie and Geissinger (1998) have identified the absence of technical support as an important source of failure in online learning. Any such miscarriage would constitute a second-order failure.

The focus group data revealed that the *frequency* with which second-order corrections need to be carried out might itself be a source of second-order failure. In a process akin to the general adaptation syndrome described by Selye (1956), students who continually have to overcome numerous obstacles when performing even simple tasks (such as holding class discussions or submitting assignments) might eventually begin to suffer from de-motivation, exhaustion or “learned helplessness.” They might simply not have enough psychological coping resources left to deal with any further challenges that are flung their way.

### ***Third-order corrections***

The examples of third-order corrections revealed by the focus group data all involve *experience-induced changes in problem-solving strategies*. While the question of whether or not experience is the best teacher may be open to debate, and while experience might teach different things to students in a virtual environment than to those in a physical environment, the *manner* in which experience imparts its lessons is surely the same for both groups. Hence, the analysis presented below does not contain any reference to differences in third-order corrective *processes* – only to differences in *necessary* third-order corrections.

## Similarities between physical and virtual educational environments

Two types of medium-independent second-order failures were described above. The first involved inefficiencies in trial-and-error, while the second involved a discrepancy between two variables: the amount of guidance or metacommunication that students require, and the amount that they actually receive. As will be shown below, the third-order corrective processes acting on these two failures are closely linked. Closing the gap between the demand and supply of guidance entails a change in one or both variables. If it is impossible for students to effect a change in the behavior of lecturers or fellow-students – as is often the case – the only remaining option is for them to change the amount of guidance that they require. But the only way of achieving this is by increasing their reliance on, and enhancing their proficiency in, trial-and-error.

It follows that students who are confronted with numerous challenges in the form of unfamiliar course content or difficult tasks, and who have limited access to external support, might eventually learn to place greater stock in their own problem solving skills. They might undergo a gradual transformation from *dependent* to *independent learners*. This transformation is an important component of the process often referred to in educational literature as **higher-order learning** (Young, 1997) – that is, the process of becoming more adept at the various activities that constitute successful learning.

## Differences in necessary corrections

It was pointed out in the previous section that metacommunication in a virtual environment tends to be less effective than its physical counterpart because (a) it is often unacceptably slow and (b) it is sometimes unintentionally omitted. This means that students in a virtual environment often have *less* access to external assistance than students in a physical environment, and therefore experience *greater* pressure to cultivate independent problem solving skills. In other words, Web-based education might, in some instances, be *more conducive to higher-order learning* than its traditional counterpart – a view endorsed by Garrison, Anderson and Archer (2000), by Dringus (2000), and others.

This conjecture is supported by the focus group data. Several respondents mentioned that, as the academic year progressed, they noticed subtle changes in their “attitude.” These changes came into sharp relief when they compared themselves with other postgraduate psychology students who were enrolled in courses delivered solely by traditional means. The “cyber-students” found themselves becoming more flexible and resilient, more autonomous and resourceful, more at ease with technology, less liable to panic when things go wrong, and more confident of their own coping skills.

The difference in necessary third-order corrections described in the previous paragraph may be regarded as a difference in *degree* rather than *kind*. The respondents’ accounts also contained one noteworthy example of a species of third-order correction that is distinctive of a virtual environment. This correction involved the *development of metacommunicative skill*. Reacting to incidents in which humorous e-mail messages were misconstrued in a serious light, one student devised a coding scheme in which text colors were used to represent various tones of voice or modes of discourse. A blue font, for instance, was defined as the metamessage “This is a joke.” The increase of metacommunicative competence may also involve the rediscovery of a skill honed to an art by many letter-writers of previous centuries: that of endowing even black-on-white text with color and feeling.

It was mentioned earlier that the scope of the available data did not allow the extension of the analysis into higher orders of failures or corrections. Only one objective stated in the introduction to this article therefore remains to be realized: that of achieving an overall view of the effectiveness of Web-based learning and teaching. This will be attempted below.

### ***Intrinsically necessary corrections and the effectiveness of Web-based learning and teaching***

The foregoing analysis reveals that Web-based education is considerably more error-prone than face-to-face instruction. Despite the fact that the asynchronous nature of computer-mediated communication confers certain advantages, it is more likely to fail as a result of misunderstandings, non-delivery of messages, inadequate computing skills, and so on. Furthermore, metacommunication

– communication aimed at preventing or rectifying misunderstandings in communication – is so cumbersome in a virtual environment as to be of limited utility. At first glance, these shortcomings appear to argue for an abandonment of high technology in favor of tried and proven methods of instruction.

If the concept of *intrinsically necessary higher-order corrections* is brought to bear on the situation, however, a somewhat more optimistic picture emerges. The very failures that seem to place Web-based instruction at a disadvantage sometimes stimulate higher-order corrections – some of which are valuable ends in themselves, and some of which are difficult to achieve in a traditional education context. The necessity of successful communication forces cyber-students to improve their computing skills, for instance, while the clumsiness of computer-mediated metacommunication forces them to become less reliant on external guidance and more adept at independent problem-solving. A liability at one level can therefore turn out to be an asset at the next.

Stoltz and Pulatie (1997) provide additional support for this argument. They have suggested that the standard measure of student potential – IQ – be supplemented by AQ (Adversity Quotient), which they define as the ability to prevail and succeed in the face of adversity. If one accepts the notion that a certain degree of adversity can sometimes stimulate AQ development, one is led to the conclusion that students often benefit *more* from programs in which things do *not* always run perfectly smoothly.

It was mentioned earlier that intrinsically and extrinsically necessary higher-order corrections might sometimes be mutually incompatible, and that such conflict situations are formally equivalent to “double binds” as defined by Bateson. Although the focus group data revealed nothing resembling a double bind, it is easy enough to think of ways in which one might arise in a virtual education environment. There have been anecdotal reports among our students of poorly designed Web courses in which the download time of prescribed literature exceeded all practical limits, thereby forcing students to “take the law into their own hands.” Every student simply downloaded a section of the course material, printed it out and made photocopies for his or her classmates. If students had been



punished or reproved for effecting this second-order correction in the manner in which course information was disseminated, they would have been forced into choosing between doing the wrong thing (not obtaining the necessary information) and doing the right thing in the wrong way (obtaining the information by illicit means). Moving beyond the realm of speculation, Star and Ruhleder (1996) claim to have identified actual examples of double binds within the context of information system infrastructure design.

## Conclusion

The recursive, open-ended nature of the framework utilized in this study appears to guarantee that the researcher will always run out of facts before running out of the theoretical means to interpret them. However, there are two reasons why such a claim would be an overstatement. First, the recursion inherent in the framework – the fact that each higher-order correction is defined in terms of its predecessor in the hierarchy – prevents it from accommodating data that are not directly or indirectly relevant to those processes that have been defined as “first-order corrections.” Its adequacy is therefore critically dependent on that initial definition.

In the foregoing analysis, for instance, first-order corrections were defined in terms of the flow of *information* from lecturers and course resources to students (during instruction and learning), and from students back to lecturers (during assessment). It contained no reference to the necessary flow of *financial currency* from students to educational institutions to lecturers. Payment for services rendered may aptly be regarded as a correction that might go awry, and hence might be in need of higher-order correction. Had the focus groups been conducted with course and Faculty administrators instead of students, they might well have contained data that would have made this broader definition of first-order corrections absolutely essential.

Second, the self-referential nature of the framework (the fact that it communicates something about human communication) ensures that it can, in principle, never be exhaustive. Following Bateson, we identified the receipt of messages with first-order corrections, since these effect changes in a person’s

beliefs about his or her world. We also identified metamessages (messages about the meanings of messages) with second-order corrections, since these change the manner in which messages are interpreted; meta-metamessages with third-order corrections; and so on. But what kind of correction do we intend to bring about by communicating this thought – this distinction between various orders of messages – to the reader? Evidently, a correction of this nature cannot be located at any particular level *within* the hierarchy, since it is *about* the hierarchy itself. The role of such extra-hierarchic corrections in learning and teaching remains to be investigated.

Two other avenues of possible future research present themselves. First, in response to McIsaac and Blocher's (1998) exhortation that the scope of research projects be extended beyond the study of individual Web-based courses, the model might be employed to *compare* various online programs. Second, the model holds out the hope of its eventual quantification. It might, for instance, be possible to operationally define certain corrections as changes in measurable variables, and to set up equations relating the *values* of higher-order variables to the *rate of change* of lower-order variables. This would render the present enquiry amenable to the methods of differential calculus, dynamical systems theory, and other analytic tools that are frequently employed in the natural sciences to describe relationships between orders of change. The question of whether the adoption of such tools would aid the social and educational sciences in achieving the goal alluded to at the beginning of this article – that of developing “a truly adequate set of descriptive tools appropriate for their subject matter” – remains at present a matter for speculation.

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## **Vitae**

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His research interests include the application of systems theoretical concepts to various areas of psychosocial research, such as the impact of apartheid on South African society and the dynamics of teaching and learning in a virtual environment.

### ***David Maree***

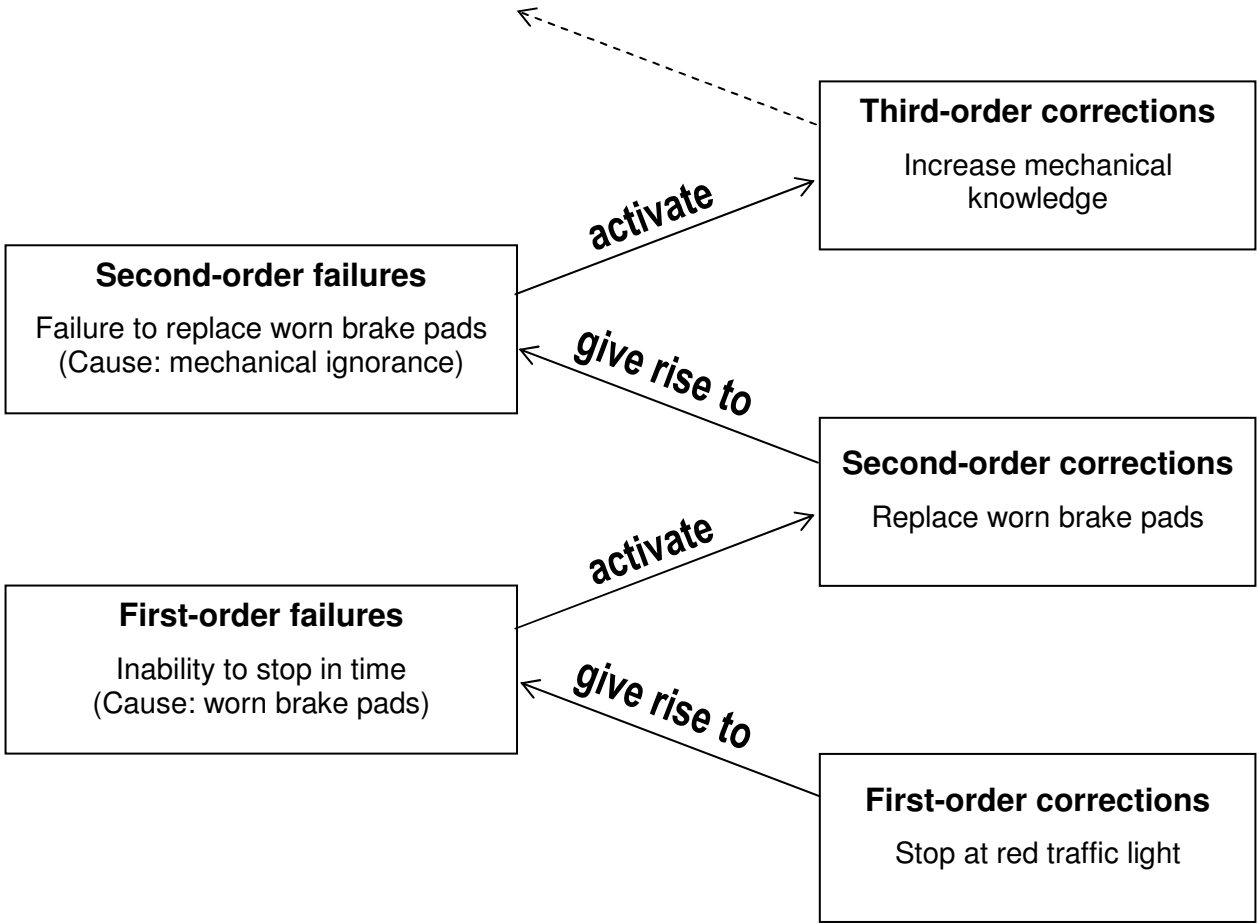
In 1999, after a twelve-year career in Traffic Research and a directorship at the Human Sciences Research Council in South Africa, David Maree was appointed as full professor at the Psychology Department of the University of Pretoria. His current duties include lecturing research methodology to graduate students, as well as the development and coordination of a telematic course for the University's M.A. (Research Psychology) degree program. He is developing a cognitive psychology module for this degree, and is involved in numerous research projects, committees, and workgroups within the University. He serves on the Department's executive committee and has acted as Head of Department on various occasions.

## Figure captions

Figure 1: A dialectic hierarchy of corrections and failures, with illustrative examples

Figure 2: Schematic summary of the data analysis





## Failures

## Corrections

**Similarities between physical and virtual environments**

**Differences in failures arising from differences in:**

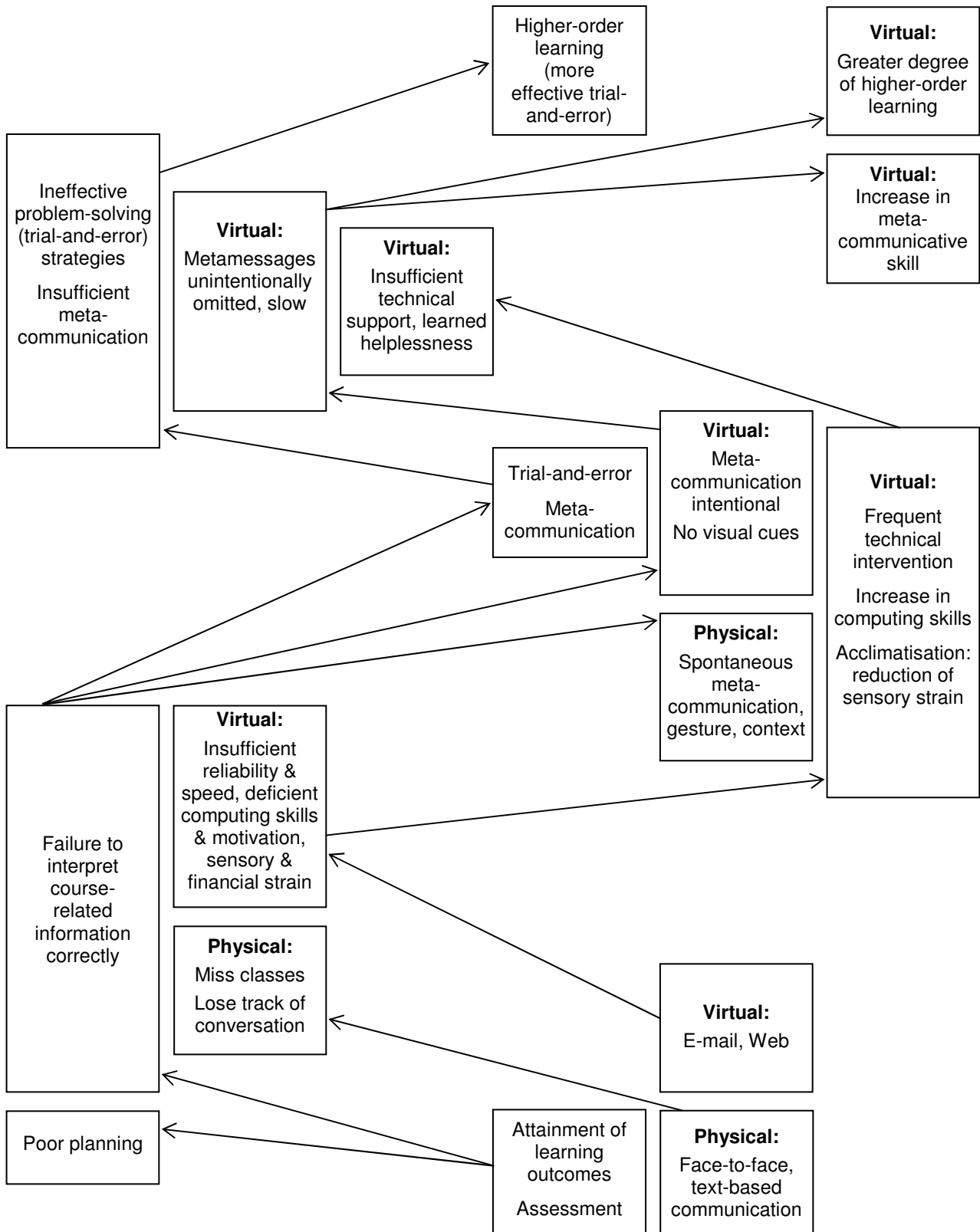
**Corrective processes**

**Necessary corrections**

**Similarities between physical and virtual environments**

**Differences in corrective processes**

**Differences in necessary corrections**



## Tables

**Table 1. Summary of the focus group data: Number of statements sorting in each category**

	<b>First focus group</b>	<b>Second focus group</b>	<b>Total of two groups</b>
<b>First-order corrections</b>	<b>7</b>	<b>6</b>	<b>13</b>
Similarities between physical and virtual educational environments	2	2	4
Differences in corrective processes	5	4	9
Differences in necessary corrections	0	0	0
<b>First-order failures</b>	<b>22</b>	<b>17</b>	<b>39</b>
Similarities in failures	7	1	8
Differences in failures arising from differences in corrective processes	15	16	31
Differences in failures arising from differences in necessary corrections	0	0	0
<b>Second-order corrections</b>	<b>4</b>	<b>7</b>	<b>11</b>
Similarities between physical and virtual educational environments	1	1	2
Differences in corrective processes	1	2	3
Differences in necessary corrections	2	4	6
<b>Second-order failures</b>	<b>11</b>	<b>4</b>	<b>15</b>
Similarities in failures	1	1	2
Differences in failures arising from differences in corrective processes	4	1	5
Differences in failures arising from differences in necessary corrections	6	2	8
<b>Third-order corrections</b>	<b>4</b>	<b>2</b>	<b>6</b>
Similarities between physical and virtual educational environments	1	0	1
Differences in corrective processes	0	0	0
Differences in necessary corrections	3	2	5
<b>TOTAL NUMBER OF STATEMENTS:</b>	<b>48</b>	<b>36</b>	<b>84</b>