Abstract

After having the motivation, desire, intentionality, and willingness to embark onto a heutagogical path of learning, one may ask the next question: “How can a learner, as a private individual, make such a journey?” This chapter offers an alternative route a learner can take by applying Dialectic Soft Systems Methodology to learn what he/she wants to learn.

Introduction

As pointed out by Kenyon and Hase (2013), the essence of heutagogy is that, in some learning situations, the focus should be on what and how the learner wants to learn, not on what is to be taught. It is one in which the learner chooses what to be learned and even how they might learn it rather than having the learned person (instructor, lecturer, mentor) pour information into the heads of the learners. Besides, Kenyon and Hase also cautioned readers that heutogogy does not purport to be the one ideal method of learning and traditional approaches to learning will be appropriate in some circumstances, especially where skills and knowledge need to be taught before the learner is considered safe to use them. In accord with these themes, this chapter describes a learning path that a learner can pursue by applying Dialectic Soft Systems Methodology (DSSM) to learn continuously and in real time by interacting with the environment. However, this paper is not suggesting that instructor control, and team work are irrelevant. Instead, it is attempting to convey some feeling for an approach that if practiced alone helps an individual to get intuitional glimpses of truth, then a whole realm of discoveries can be achieved through help from instructors and the learner’s team members.

Dialectic version of Checkland’s Soft Systems Methodology

Soft Systems Methodology (SSM) was developed by Peter Checkland and his colleagues at Lancaster University in the 1970s using action research with an industry partner (Checkland, 1999; Dick, 1999; Sankaran, Tay & Cheah, 2003; Tay & Lim, 2007). SSM was adopted by Checkland and his colleagues to address ‘soft’ problems in social systems in which goals were often obscure as distinct from ‘hard systems’ that were goal-directed.

Most people use Checkland’s seven-stage model (Checkland, 1981, 1999; Wilson, 1984, 2001; Checkland & Scholes, 1990; Checkland & Holwell, 1998; Currie & Galliers, 1999; Flood, 1999; Dick, 2000; Curtis & Cobham, 2002; Maani & Cavana, 2002; Tay & Lim, 2007) and the seven stages are:

1. The problem situation ‘unstructured’
2. The problem situation ‘expressed’
3. ‘Root definition’ of relevant systems
4. Build ‘conceptual models’
5. Compare the ‘conceptual models’ with the ‘real’ world.
6. Think about feasible, desirable changes
7. Take action to improve the problem situation.

SSM involves considering the problem situation in both the ‘real’ world (Stages 1 and 2) and the ‘model’ world (the abstract model) where systems thinking is applied to develop root definitions to clarify the real problem and conceptual models are developed to look at ideal solutions (Stages 3 and 4). The “ideal” models are compared to the actual situation. Differences between the models and reality become the basis for planning changes (Stages 5, 6 and 7).

As highlighted by Flood (1999), Checkland (1999), Tay (2003), and Tay and Lim (2007), Soft Systems Methodology is not a method that can be laid out in a set of stages to follow systematically. Checkland was fully aware of this difficulty when he formulated the “7-stage” model to act as a pedagogical tool to put forward Soft Systems Methodology Principles. Checkland had made considerable effort to explain the “7-stage” model as a continuous process of learning, which researchers begin anywhere and move in any direction despite it is explained within the limitations of linear prose.

The need for the “7-Stage” model to be understood as a learning cycle has prompted Dick (1993) to think of soft systems methodology as progressing through four dialectics, as described below.

However, it is important for readers to note that Dialectic Soft Systems Methodology (DSSM) is not a new form of Checkland’s Soft Systems Methodology. It is the same process as the “7-stage” description except it is presented from a different perspective. As described by Dick (1993), Dick and Swepson (1994), Dick (2000), Sankaran, Tay and Cheah (2003), Sankaran and Tay (2003), Tay (2003), and Tay and Lim (2004, 2007), this approach makes explicit the inherent cyclical nature of Checkland’s seven stages and the use of dialectic comparisons. It progresses through four dialectics (see Figure 1).

- 1st dialectic – Between immersion (rich picture) and essence (root definition, abstract model), where a learner tries and experiences the problem situation as fully as possible and then stands back and defines its essential features – the root definitions or an abstract model (i.e. between Stages 1+2 and 3 of Checkland’s model).

- 2nd dialectic – Between the essence (root definitions or an abstract model) and the ideal (conceptual model) where the learner tries to find an ideal way to achieve the same transformation of inputs into outputs (i.e. between Stages 3 and 4).

- 3rd dialectic – Between the ideal and reality where the learner thinks about improvement to the ideal or the actual situation (i.e. between Stages 4 and 5).
- 4th dialectic – Between plans and implementation where the plans are implemented and differences between plans and reality can be monitored, through which further improvements can be carried out (i.e. between Stages 5 and 6+7 and back to Stage 1).

Figure 1: Dick’s Dialectic version of Checkland’s Soft Systems Methodology (Dick, 1993, 2003; Tay, 2003; Tay & Lim, 2007)

As pointed out by Dick (1997 and 1999b), the dialectics have a win/win intent. They focus on disagreements and seek to turn these disagreements into agreements. Out of the dialectic between opposing views, greater understanding may emerge. In addition, each dialectic can be assigned an action research cycle (Tay, 2003).

Features of DSSM that support Heutogogy

Let’s look now at those features in DSSM that support a heutogogical mode of learning.

Supports three modes of learning

DSSM supports three modes of learning, namely, pedagogy, andragogy, and heutogogy. The learner undergoes didactic, pedagogical form of training in the 1st dialectic where the learner must develop certain skills or knowledge in order to get started in a completely new area. Armed with this initial knowledge, the learner proceeds into the andragogical mode of learning in 1st dialectic by trying, experiencing, and clarifying the problem situation as fully as possible until he or she
is able to construct an abstract model for his or her problem context. As pointed out by Tay (2003, 2013) and Giunchiglia and Walsh (1992), an abstract model is a one-to-one mapping of the problem situation, preserving certain desirable properties (such as our mental association with certain physical structures in the physical world) and throwing away undesirable properties not related to the problem context (such as our mentality associated with the multifarious irritations, pleasures, worries, excitements and the like that fill our daily lives). According to Mazur (2007), abstraction includes separating what we want from what we are presented. If it is whiteness we want to think about, we must somehow separate it from white horse, white car, white cholate, and all the other white things that is invariably must come along with, in order for us to experience it at all.

The importance of an abstract model can be appreciated via Mendeleev’s periodic table used in chemistry (Tay & Hase, 2010; Tay, 2013). Mendeleev only discovered 60 elements in the 1860s and he was the first to have the courage to leave open gaps in the classification, instead of trying to impose an artificial completeness on it. These ‘deliberate open gaps’ are the boundaries of known elements to ‘enclose’ the area of ‘unknown’ elements. In other words, the application of boundary in an abstract model is not imposed from outside the system, rather it emerges because of differences within the system itself (Eoyang, 1996).

The learner enters the heutogical mode of learning in 2nd Dialectic, 3rd Dialectic, and 4th Dialectic to seek out new knowledge associated with the “deliberate open gaps” in the abstract model.

Let’s look at an example taken from the work of Tay (2003). Tay and his colleagues used DSSM to develop an Expert System for a military vehicle as illustrated in Figure 2.

1st Dialectic
In this stage, the modeler immerses himself or herself in the problem situation. The modeler undergoes a didactic, pedagogical form of training by attending the driving course and the maintenance course. After the modeler has acquired all the relevant safety procedures in operating the vehicle, he or she proceeded into the andragogical mode of learning by trying to capture the essence of a selected vehicle operation such as starting, driving, stopping or parking the vehicle. The modeler switches between the real vehicle and the descriptions of the selected vehicle operation as many times as needed until a satisfactory description (the abstract model) for that vehicle operation is obtained.

2nd Dialectic
This stage is used to construct the Diagnostic Expert System (DES model), an ideal systemic model for representing that vehicle operation. It is the dialectic between the essence (the abstract model) of the vehicle and the DES model. As suggested by Dick (1993), the modeler should forget about the real vehicle and concentrate on the derivation of the DES model from the essence (abstract model) obtained in 1st dialectic. Here, the modeler took up the heutagogical mode of learning to ensure he or she is able to capture the wholeness of the vehicle operation by seeking new information and knowledge associated with the ‘deliberate open gaps’ in the abstract
Again, the modeler alternates between the essence and the DES model until he or she is satisfied with the final DES model for the selected vehicle operation.

3rd Dialectic
This stage is the dialectic between the DES model constructed in 2nd dialectic and the real vehicle. Here, the modeler performs task analysis. Task analysis is the process of analysing the way people perform their jobs which include the things they do, how they act and the things they need to know (Gordon, 1994; Dix, Finlay, Abowd & Beale, 1997). The modeler used the heutagogical mode of learning in this stage to derive all the required inspection and repair tasks needed by the DES model including the portions of DES model associated with ‘deliberate open gaps’. This stage is repeated where necessary until the modeler is satisfied with the derivation of all mandatory inspection and repair tasks. At the end of this stage, the modeler will determine the set of fault cases based on the failure causes. The cases are then consolidated into a test plan.

4th Dialectic
This stage is the dialectic between the test plan and the real vehicle. The test plan is verified against the real vehicle. The modeler compares the DES model to the real vehicle and notes down the differences encountered during the execution of the test plan. The modeler continued to use the heutogogical mode of learning in this stage as the test plan included the content associated with ‘deliberate open gaps’.

Figure 2: The 4-Stage DES inquiry process (Tay, 2003)
The incorporation of three modes of learning offers a learner a complete learning experience without compromising safety or knowledge that needs to be taught using traditional, didactic, pedagogical forms of teaching. This feature strikes at the heart of DSSM as a process in which the learner’s assumptions and understandings are repeatedly tested in the real world by action; nothing is taken for granted.

Besides, this complete learning experience favours the transition from ‘understanding’ (via 1st and 2nd dialectics) to utility (via 3rd and 4th dialectics). As pointed by Good (1983), the path from ‘understanding’ to utility is more convincing than vice versa. People’s value judgments (also known as utility judgments) are liable to be in disagreement. For example, values can be judged with a fair amount of agreement when the commodity is money, but not when deciding between, say, our own life and the life of some other person. Because of the lack of understanding in the ‘utility-to-understanding’ path, we may not be able to say which of them has the larger expected utility. Both courses of action may be reasonable and a decision may then made by ‘make up one’s mind’. As highlighted by Good (1983), decisions reached in this way are not usually reversed, owing to the negative utility of vacillation. Hence, if a person places too much value to the negative utility of vacillation, he or she is no longer a “learner” but an ‘obstinate’ practitioner instead!

**Applies systems thinking**

Systems thinking provides a learner with a means for seeking ‘deliberate open gaps’ by viewing a system as a whole that is more than its parts such that the differences between the whole and its known parts are identified as the ‘deliberate open gaps’ (Heylighen, 1995; Day, 1995; Checkland, 1999; Davies, 2001). In DSSM, systems thinking is applied in all the dialectics. It is applied in 1st dialectic to clarify the problem situation (the reality) and is used in 2nd, 3rd, and 4th dialectics to seek out the new knowledge in the ‘deliberate open gaps’. The next question is: How to apply systems thinking? Kasser and Mackley (2008) offers the following three steps for applying systems thinking:

**Step 1:**
A thing to be understood is conceptualized as a part of one or more larger wholes, not as a whole to be taken apart.

**Step 2:**
An understanding of the larger system is sought. The system is viewed as a black box. This perspective shows the inputs and outputs and their relationships. This corresponds to the traditional ‘open system’ view. The black box perspective abstracts out (filters) the details of the internal nature of the system providing a view of the forest rather than the individual trees.

**Step 3:**
The system to be understood is explained in terms of its role or function in the containing system. – its environment, the closely coupled adjacent systems with which it interacts and any loosely coupled more distant systems. The explanation contains information about the external boundary of the system and the assumptions behind the location of the boundary.
Step 1 of Kasser and Mackley (2008) can be achieved through the notion of anchoring. Humans exhibit a phenomenon called anchoring in which an initial estimate, no matter how inaccurate, can serve to guide subsequent responses (Reber, 1995; Manktelow, 1999; Parkin, 2000; Molden, 2001). This initial estimate, also known as an anchor, is a foundation from which the thing in step 1 is understood in terms of the interrelationships, and interdependencies of other things in a larger whole that serves a unique function.

Step 2 looks at the transformation brought about by the thing (the anchor) in step 1. The transformation is the process that converts a set of inputs into a set of outputs (Checkland & Scholes, 1990; Mirijamdotter, 1998; Dick, 2000). This step is carried out by asking: What resources are transformed into what outputs by the thing? The resources are the set of other things connected just before the thing. The outcomes (outputs) from this transformation process are applied to the set of other things connected immediately after the thing. As pointed by Heylighen (1995a), the transformation itself must be invariant. The change following or preceding a transformation must not be unique, but share some properties with changes associated with similar transformation. The more invariant the causal relationship, the more generally reliable and applicable it is. Heylighen offers two criteria for seeking this invariance. The first criterion is called invariance over time (consistency). It refers to a perception that what appears or disappears suddenly, is unlikely to be caused by the thing. The second criterion is invariance over persons (consensus). It refers to a perception in which different observers agree is more likely to be real than one that is only perceived by one person.

Step 3 applies the notion of ‘boundary’, the imaginary line that delineates what is consider to be the whole (where the thing resided) from what is outside (Fortune & Peters, 1995). This step also applies to other wholes that are either closely coupled or loosely coupled to the whole.

After applying all three steps above, ‘deliberate open gaps’ can be identified by the following areas:

- Unexpected input. The thing makes many assumptions about its inputs. What happens when a new input or an existing input with a different format is applied to the thing?
- Unexpected output. The thing produces a set of outputs to be used by other things within the whole. What if any of its outputs is incomplete or wrong?
- Logical Error. The transformation simply doesn’t do what it is supposed to do?

Therefore, the adoption of systems thinking in all dialectics helps a learner to appreciate: the architecture of an ideal model that is larger than the abstract model; its internal subsystem partition boundaries; its enclosed ‘deliberate open gaps’ (brought about by either the boundaries of known subsystems or by the differences between the ideal model and its known subsystems); and any effect on this ideal model due to its internal structure and the ‘deliberate open gaps’. The ‘deliberate open gaps’ will in turn raise a new set of questions to motivate a learner to seek definiteness, consistency, and causes – in short, we just have to find and fix the gaps.
Adopts morphisms of Action Research

We need to transgress the boundaries of known systems in order to seek out new knowledge in ‘deliberate open gaps’ (Tay, 2013). Dick (2001, p.1) suggested this can be performed using action research by the following two paragraphs, namely,

“In situation $S_1$, to achieve Outcomes $O_1$, try Action $a$.

And if the plan includes also the assumptions underlying the definition of situation, actions, and outcomes, it is likely that both action and reflection will be enhanced”.

Interestingly, Dick’s first paragraph carries the meaning of practising physics! According to Coecke (2005), what is meant by the phrase ‘practising physics’ is that we take a physical system of type $S_1$ (such as a proton or an electron) and perform an operation $a$ on it (for example, perform a measurement on it) which results in a system of a different type $O_1$ (either the system together with classical data that encodes the measurement outcome, or just classical data in the case that the measurement destroyed the system). So typically we have the following expression:

$$a: S_1 \rightarrow O_1$$

where $S_1$ is the initial type of System, $O_1$ is the resulting type and $a$ is the operation or process. This first try serves the important role of helping us understand the System. However, we must always make sure that such a relative thoughtless and unplanned first try does not steal too much time before we have done at least a bit of analysis (understanding the system) and design (deciding on an overall structure of a solution/plan).

Dick’s second statement suggests that we can perform another operation or process after $a$.

$$b: O_1 \rightarrow O_2$$

where $O_1$ includes the assumptions and information on situation $S_1$, outcome $O_1$, and the action $a$. Since the resulting $O_1$ of $a$ is also the initial type of $b$, we write $b \circ a$ for the consecutive application of these two operations. We can think of $a$ and $b$ as ‘transformations’, and composition of them means that we imagine ‘first’ applying $a$ to get us from $S_1$ to $O_1$ and ‘then’ applying $b$ to get us from $O_1$ to $O_2$.

Likewise, we can apply operation $c$ for $O_2$ and so on.

$$c: O_2 \rightarrow O_3$$

$O_1, O_2, O_3, \ldots$ represent consecutive new systems with increasing degree of improvement (or understanding) and the subscript indicates the number of iterations we have taken to attain our intended outcome.
Clearly, we have \((c \circ b) \circ a\) and \(c \circ (b \circ a)\) since putting the brackets merely adds the superficial data on conceiving two operations as one.

If we further set

\[1_S: S_1 \rightarrow S_1\]

for the operation ‘doing nothing on a system of type \(S_1\)’. That is to say, by having no action done on \(S_1\), \(S_1\) is clear from the context of operation/process and thus retains its identity. The identity mapping \(1_S\) then plays the role of “unit” mapping.

Alternatively, if we consider \(\text{s}_1, \text{O}_1, \text{O}_2, \text{O}_3, \ldots\) as objects, \(\text{a}, \text{b}, \text{c}, \ldots\) as morphisms (or maps or arrows), \((c \circ b) \circ a\) and \(c \circ (b \circ a)\) as associative compositions, and \(1_S\) as the identity morphism, we have turned Dick’s two paragraphs into a mathematical category theory that comprises these four distinct mathematical features (Asperti & Longo, 1991; Fokkinga, 1994; Barr & Wells, 1998; Turi, 2001; Oosten, 2002; Pareigis, 2004; Simmons, 2010; Spivak, 2013).

The reason for relating category theory to action research is simple - category theory offers the mathematical structure for practising action research. While doing action research, we are also performing the art/act of deriving a mathematical model or packaging a mathematical theory (via category theory) for the situation-specific context in which we are immersing. The new knowledge (also known as research outcomes) for the ‘deliberate open gaps’ are not merely descriptions, prescriptions, or speculations, it is generalized by the unifying power of mathematical structures and constructions in category theory, such that the new knowledge derived using action research counts as a valid public knowledge.

*Incorporate four of Jung’s psychological types*

As mentioned by Dörner (1996), in dealing with complex problems we cannot handle\(_2\) in the same way\(_2\) all the different situations we encounter. Sometimes we must perform detailed analyses; at other times it is better to simply size up a situation. However, there is no universally applicable rule that we can apply to every situation and to all the structures we find in the real world. The best approach is to have everything at its proper time and with proper attention to existing conditions.

In addition, human intellectual endeavour does not always proceed through deductive and inductive reasoning. According to Davies (1992) and Penrose (1989), the key to major scientific advances often rests with free –ranging imaginative leaps or inspiration. In such cases, an important fact or conjecture springs ready-made into the mind of the learner, and only, subsequently is justification found in reasoned argument. Therefore, it is important for us to capture these inspiration flashes with a view that they may bring about ‘breaking through’ understandings or findings.

The notion of ‘everything at its proper time and with proper attention to existing conditions’ and the notion of ‘inspirational flashes’ prompted Tay (2003) to incorporate four of Jung’s psychological types, namely, intuitive feeling (NF), intuitive thinking (NT), sensate thinking (ST) and sensate feeling (SF), as the decision-making preferences that were similar to those described by Kilmann (1979) and Dick (1994) into DSSM.
Dick (1994, p10) used the terms ‘left brain’ and ‘right brain’ as technical labels of convenience rather than geographical descriptions for explaining the meaning of NF, NT, ST and SF later in this section. The meanings of ‘left brain’ and ‘right brain’ are given by Dick (1994, p10) as follows:

Your left Brain is your verbal and rational brain; it thinks serially and reduces its thoughts to numbers, letters and words. Your right brain is your non-verbal and intuitive brains; it thinks in patterns, or pictures, composed of ‘whole things (including inspirational flashes)’ does not comprehend reductions, either numbers or letters or words.

Dick (1994, p.20) uses the serial-parallel distinction of ‘left brain’ and ‘right brain’ to explain the meaning of NF, NT, ST and SF as follows:

NF is the right-brain operation and it is creative, impressionistic. In this mode of operation, perception and judgement are often rapid and compelling. On the other hand, the reasons for arriving at the percept or the conclusion are often lacking or suspect. NF mode operates at the most general level. It is applied when a problem is being noticed and no explanation can be made.

NT mode shares with NF mode the use of the right brain for perception. Ambiguity and complexity can therefore be managed. The left brain is used for analysis and judgement. In this mode, the available information is processed deliberately and systematically.

ST mode is the left brain operation and it is serial and analytical in both perception and judgment. It is logical, systematic, and most suited to activities where there are clear-cut problems and established procedures.

SF mode uses both brains. But perception is done with the analytical left brain, and judgment with the more global right brain. Left brain perception provides practical talents. Right brain judgment allows working easily with people. SF allows a person to take into account the idiosyncrasies of the situation and the people.
The incorporation of NF, NT, ST and SF in the 4-Stage DES inquiry process is shown in Figure 4.

Figure 4: Dick’s Dialectic version of Checkland’s Soft Systems Methodology with four of Jung’s psychological types (Tay, 2003)

Using the previous example of Tay (2003) for developing an expert system. NF is the dominant mode of experience in the 1st dialectic where the modeler is expected to be immersed in the problem situation. At the start of a modeling process, the information is usually vague, unclear and fuzzy. Because the learning experience is processed outside of awareness, there may not be much conscious reflection on the learning. There may not be many chances to generalise from it. Thus, the modeler only identifies the important features about a given vehicle without much analytical effort.

It may be recalled that a learner enters the heutological mode of learning in 2nd Dialectic, 3rd Dialectic, and 4th Dialectic to seek out new knowledge associated with the “deliberate open gaps” in the abstract model.

NT is the dominant mode of experience in the 2nd dialectic where the modeler concentrates on the construction of DES model. In this mode, the modeler is expected to have gathered sufficient information from the NF mode. Generalisation can be drawn from the patterns emerged from the information. In other words, the NT mode takes the form of generalizations drawn from experience.

ST is the dominant mode of experience in the 3rd dialectic where the modeler performs a task analysis to derive the required inspection and repair procedures.
SF is the dominant mode of experience in the fourth sub action research cycle where the modeler verifies the DES model against the actual vehicle. In this mode, apart from the capacity to work with detailed plans, the modeler is expected to be able to take specific features of the situation into account and to check his or her model(s) against those specific features.

Therefore, as described above, the incorporation of four of Jung’s psychological types helps a learner to pursue a learning journey with thing handled in a proper way, with proper attention to existing conditions, and with constant lookout for ‘inspirational flashes’ via the ‘right-brain’ operation associated with respective Jung’s psychological type.

Conclusion

As illustrated in this paper, DSSM provides a learner a heutogical journey into the unknown via its 2nd, 3rd, and 4th dialectics. Each advance we make can bring new and unexpected discoveries, and challenges our minds with unusual and sometimes difficult concepts. But, through it all runs the familiar thread of rationality and order. The reader is invited to share this DSSM excursion into the unknown, in search of the basis of reality that he or she wants to learn.

References


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