The Benefits of Critical Path Analysis in Doctoral Research

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Abstract

The opportunity to offer online doctorate degrees has led to a large influx of students. These students often have wide vocational experience, in which they have encountered educational problems, so they come to doctoral research with no shortage of potential research topics. With no shortage of students or ideas, there is opportunity to broaden the range of dissertation topics that faculty need to supervise. This is beneficial in that it avoids narrow focus on relatively few popular topics. It gives opportunity for rapid research response to dangerous national and global crises. However it raises the question of how to manage more and larger research projects coming from more diverse students. In addition to wider cultural and cognitive diversity, they have wider functional diversity, often juggling doctoral research with demanding full-time high-level occupations, and they come with benefit of wider experiential facility. However, these positive qualities pose challenges for supervising faculty, who may have more powerful cognitive research lenses, but narrower handles on the functional and experiential domains than these new breeds of student. In this article, the advantages of applying critical path analysis are described, ranging from the input of tasks to the display of progress by Gantt (1974) and Pert (Fazar, 1959) charts. Critical path analysis provides visual display beyond and above current textual and flow charts. It creates interaction between research committee and student in time management. Since few doctoral dissertations succeed in achieving their initial target dates, critical path analysis will show how to forecast and achieve revised completion dates when the project discovers unexpected barriers. These barriers can emerge in cognitive, functional or experiential domains. While discovered barriers in doctoral research present initial frustration and delay to both student and supervisor, they

have often been the lifeblood of furthering knowledge, skills and attitudes at micro and mega levels of society.

Keywords

Research supervision, Project management, Time management, Online doctorate, Dissertation sequencing.

Introduction

Barriers to doctoral research

Cleeton G. (1996) developed a terminology of learning barriers to help students and faculty in the institution which founded distance learning - namely the British Open University. These barriers were evident in three domains. Examples are given in the following list -

- Cognitive - 'I can't do Mathematics'
- Functional - 'I am short of time'
- Experiential - 'I haven't done anything like this before'

Within these three domains he classified learning barriers as Perceived, Anticipated, Real, Illusory and Discovered. In doctoral research one of the most exciting, but paradoxically one of the most difficult, learning barriers is the *Discovered* barrier (Getzels, 1964). Getzels proposed a taxonomy of types of learning barrier. If a student is academically robust he or she will often make original contributions to knowledge from an encounter with a Discovered barrier, on the other hand it may floor a weaker student. If we can take off the stress of such encounters by effective time management, provided by critical path analysis (CPA), the weaker student may yet survive to completion. The size of current Ph.D. projects is equivalent to many industrial projects which would not be considered feasible without project management by critical path.

Cleeton L. (2001) has analyzed the external representations used in the thinking process of problem-solving. She has shown that factors such as cognitive style play a prominent part in problem-solving. For example, analytic learners may be at an advantage over a wholistic learner in solving a problem of sequencing in a dissertation.

Current and proposed online doctorate process

Functions of the research committee

In the attempt to raise the standard of the widening influx of doctoral students, rather than letting them sink or swim an ever-increasing structure has been imposed on the dissertation process. Hardly ever has deadwood been pruned, but almost invariably extra structure has been imposed under the assumption that 'more is better'. Common sense would however dictate that there is an optimal level of structure, since as in the Yerkes-Dodson Law (Yerkes & Dodson, 1908) where an optimum level of stress or challenge is found to give maximum achievement, there is probably a level of structure beyond which it becomes self-defeating. We see this in the anxiety-producing effect produced on a procrastinating student when the goal-posts are changed. While a student is making slow but best-practice progress, suddenly the goal-posts are changed from above and further assessments are imposed, such as ever-increasing detail from Institutional Review Boards. Changing goal posts during a long-term dissertation is likely to inhibit the quality of intuition necessary for creative and divergent thinking. You are not likely to be optimistic that there is more than one way to solve a discovered barrier if your line manager frequently changes the goal-posts.

If we are to broaden the base of online doctoral research topics, we may have to loosen the structure by paradoxically using more complex, but however user-friendly, strategic software to guide the student and the dissertation committee through the mass of detail so that the students' creative and divergent thinking remains energetic. The goal is to provide infrastructure which is internalized - operational in the background, so that it does not produce noise in the flow of the dissertation system.

In the United States a research committee will typically consist of a chair, a methodologist and perhaps sporadic monitoring by research review at a higher level in the organization. There will be periods of intervention, for example by Institutional Review Board prior to pilot tests and final research experiments. All this is conducted in a hierarchical structure, in contrast to that in Europe where the structure may be consensual rather than hierarchical, with student and supervisors almost on equal status for the period of the dissertation (LSE, 2013). The LSE Handbook discusses the strategies for re-negotiating the status of the student-supervisor relationship

from hierarchical to consensual.

In a hierarchical structure a short period of intense training of the chairperson in user-friendly critical path software may enable logical time management of the research project to be seen, used and indeed modified where necessary by the student.

Task Analysis

In critical path analysis, a first task is to list the proposed project activities. This seems a rudimentary activity, but we must remember that the Ph.D. student is trying to make an original contribution to knowledge, so the activity needs much speculation. Sometimes we see the temptation at this stage to shelve brain-storming speculation in adequately-large groups and be content to tell the student to write a one-page premise, then when that is done to write a two-page prospectus, then a five page proposal, and so on. This incremental serial method of working is deceptively vulnerable to wholists losing a global picture of the project and even if that is retained, it is subject to catastrophe from crisis management of unexpected events.
Critical path software enables the student to preserve and operate generality before specificity, so it enables aims, goals and objectives to be progressed. In practical terms it facilitates progressive framing of major activities onwards through fine structure of discrete activities to a series of behavioral objectives each containing a specification of initial and expected terminal behaviors.

Sequencing of Tasks

Many universities have seen the need for students to be given textual instructions for the dissertation process. Yet others have seen the need to cater for diverse learning styles of the students, in particular imagers and visualizers (Cleeton, L., 2002). Tufte (2001) has published strategies for visual display of almost any quantitative information. Therefore we have seen flow diagrams of varying degrees of sophistication. Software for Critical Path Analysis can further display the sequencing of tasks in a variety of formats, starting with the Gantt chart and proceeding to the Pert chart. Examples of these will be shown to you, preceded by their Task Analysis, in four files, called *'Perceived Gantt', 'Perceived PERT', 'Real Gantt'* and *'Real PERT'*.

One of the authors of this article (Cleeton, G.) used the full version of Microsoft Project in grant applications to the European Social Fund. At its most sophisticated level, the software was used to control a seven-nation seven-language project to design an assistive technology sound card for use in speech recognition by children and adults with disabilities. In that project it was necessary to use the software add-ons of Equalization of Resources and Risk Assessment provided by the software, in conjunction with a Tracking Gantt to monitor deviations from Critical Path. Familiarity of Ph.D. students with basic critical path analysis would be useful to introduce post-doctoral students to these advance add-ons.

Two examples of Critical Path Analysis

We now show four files at http://gcleeton.wix.com/gil-c

ICEL Perceived Gantt - this shows initial Task Analysis and Gantt Chart

ICEL Real Gantt - shows modified Tasks and Gantt after encountering barrier

ICEL Perceived PERT - this shows initial perceived PERT plan

ICEL Real PERT - shows modified PERT after encountering barrier

At page 11 of the *Real PERT* file it shows how the student encountered a Discovered Barrier in that only three time-windows were available in which she could travel abroad and be accepted to do her research experiment. The Critical Path in these files now break into options, but immediately shows some mandatory tasks and times. This is shown page 11 and onwards of the *Real PERT* file. The student-committee team can now decide to target the original target date with some penalties, or can forecast the delay if they choose another path.

We have chosen to inject this one simple restraint of time windows into the *Perceived* files for purposes of illustration, bearing in mind that the consequences of discovering barriers or of the administration suddenly changing goal-posts can be complex, sometimes catastrophic. Critical Path Analysis can often point the way through apparent catastrophe to student success.

Conclusion

Acknowledging that Critical Path Analysis (CPA) needs a few months of training to produce a University-wide template, once that template is provided it does give infrastructure which the student can internalize. It moves

the doctoral process from flow-chart mentality to give student and supervisor much more interactive strategies to apply with the important resource of time. It does not lock a target date. It predicts a revised target date when a discovered barrier or limitation is encountered. At base level it gives a Task Analysis. Successively it provides Gantt and Pert Charts. It suggests a Critical Path (CP). It can provide Risk Analysis and Equalization of Resources so that the Student-Committee-Review team is balanced in its efforts.

The four specimen files are available for discussion.

Acknowledgements

The files can be viewed as described from the link given in this article but if desired the original Microsoft Project mpp files are also available from the authors on request. If they are requested but Microsoft Project is not available, they can be viewed with free viewers available for download from the Internet.

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