

Theory driven research designs

(version 0.9, 1/4/05, some examples in french)

Code: res-design-quant

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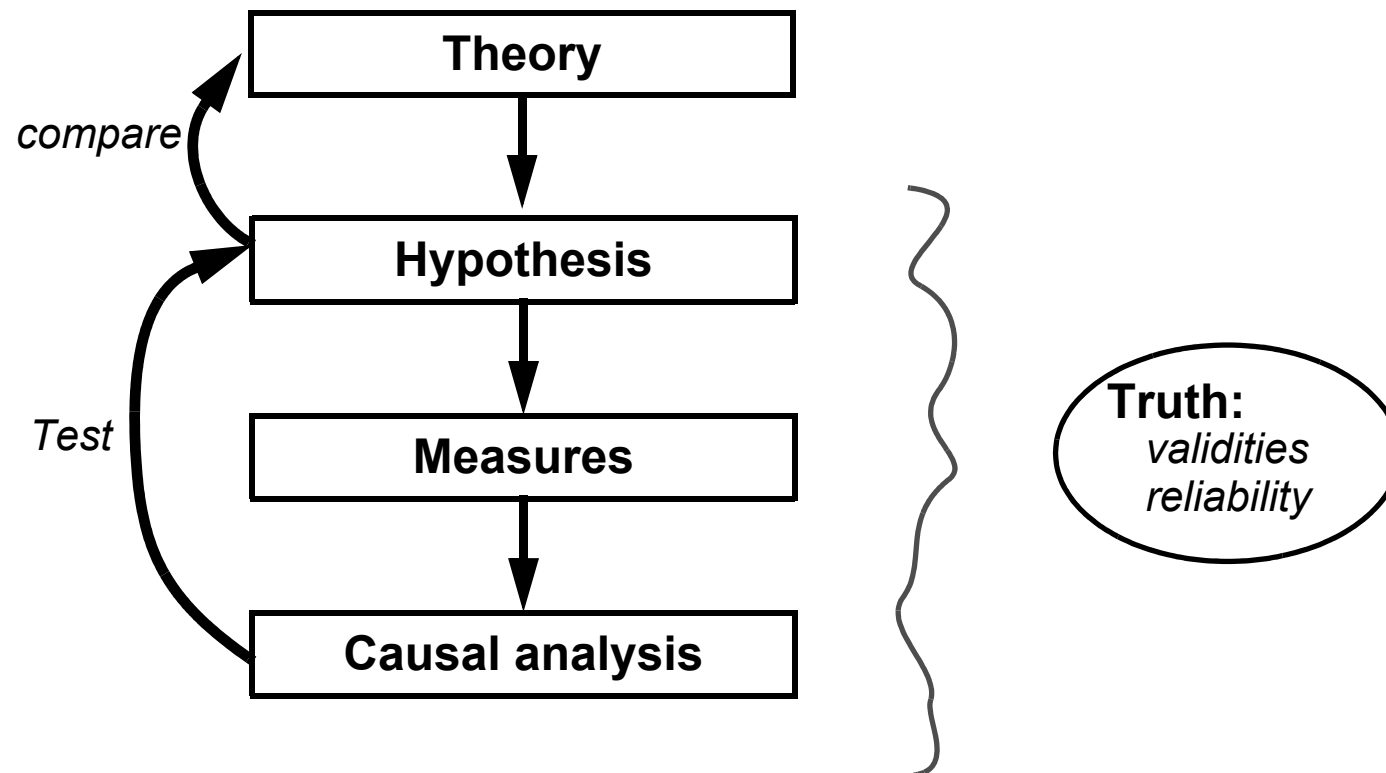


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1. Theory driven research

Most important elements of an empirical theory-driven design:



- **Conceptualisations:** Each research question is formulated as one or more hypothesis. Hypothesis are grounded in theory.
- **Measures:** are usually quantitative (e.g. experimental data, survey data, organizational or public "statistics", etc.) and make use of artifacts like surveys or experimental materials
- **Analyses & conclusion:** Hypothesis are tested with statistical methods

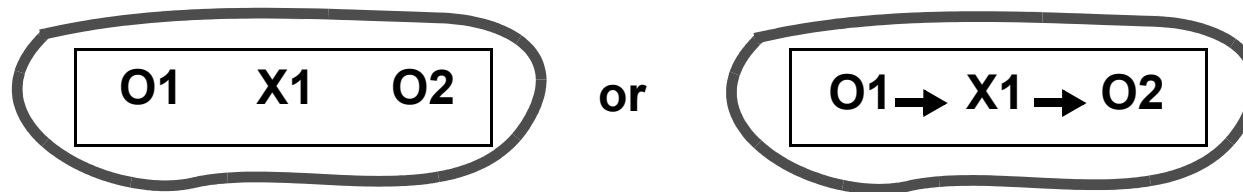
2. Experimental designs

2.1 The scientific ideal

 **Control physical interactions between variables**

Experimentation principle in science:

1. The study object is completely isolated from any environmental influence and observed (O_1)
2. A stimulus is applied to the object (X)
3. The object's reactions are observed (O_2).



- O_1 = observation of the non-manipulated object's state"
- X = treatment (stimulus, intervention)
- O_2 = observation of the manipulated object's state".

 **Effect of the treatment (X): the difference between O_1 and O_2**

2.2 The simple experiment in human sciences

 It is not possible to totally isolate a subject from its environment

Simple experimentation using a control group :

R	X	O	experimental group
R		O	control group

X =stimulus,
(independent explanatory variable)

O =mesure
(dependant variable, to explain)

Principle:

- Two groups of subjects are chosen randomly (R) within a mother population:
 - this ought to eliminate systematic influence of unknown variables on one group
- Ideally, subjects should not be aware of the research goals
- The independent variable (X) is manipulated by the researcher (experimental condition)

Analysis of results: effects are compared:

	effect (O)	non-effect (O)	
treatment: (group X)	bigger	smaller	100 % vertical comparison
non-treatment: (group non- \bar{X})	smaller	bigger	

- What is the probability that treatment X lead to effect O ?

(b) Simple experiment with different treatments:

R	X1	O1	experimental group 1
R	X2	O2	experimental group 2
R	X3	O3	experimental group 3
R	X..	O..	

- a slightly different alternative
- Example: First students are assigned randomly to different lab sessions using a different pedagogy (X) and we would like to know if there are different effects at the end (O).

**Problems with simple experimentation:**

- Selection: Subjects may not be the same in the different groups
 - Since samples are typically very small (15-20 / group) this may have an effect
- Reactivity of subjects: Individuals ask themselves questions about the experiment (compensatory effects) or may otherwise change between observations
- Difficulty to control certain variables in a “real” context
 - Example: A new ICT-supported pedagogy may work better, because it stimulates the teacher, students may increase their attention and work input, groups may be smaller and individuals get more attention.
 - In principle one could test these variables with experimental conditions, but for each new variable, one has to add at least 2 more experimental groups,

2.3 The simple experiment with pretests:

R	O1	X	O2	experimental group
R	O3		O4	control group

- To control the potential difference between groups: compare $O_2 - O_1$ (difference) with $O_4 - O_3$
- Disadvantage: effects of the first measure on the experiment
Example: (a) If X is supposed to increase pedagogical effect, the O_1 and O_3 tests could have an effect (students learn by doing the test), so you can't measure the "pure" effect of X.

The Solomon design:

R	O1	X	O2
R	O3		O4
R		X	O5
R			O6

- combines the simple experiment design with the pretest design:
- and we can test for example: $O_2 > O_1$, $O_2 > O_4$, $O_5 > O_6$, $O_5 > O_3$

Note: comparing 2 different situations is NOT an experiment ! The treatment variable X must be simple and uni-dimensional (else you don't know the precise cause of an effect)

- There are more complicated designs to measure interaction effects of 2 or more treatments

A. The non-experiment: what you should not do

The experiment without control group nor pretest:



Exemple 2-1: A bad discourse on ICT competence of pupils

"Since we introduced ICT in the curriculum, most of the school's pupils are good at finding things on the Internet"

There is a lack of real comparison !!

- We don't compare: what happens in other schools that offer no ICT training ? (Maybe this is a general trend since more households have computers and Internet access.)
- We don't even know what happened before !

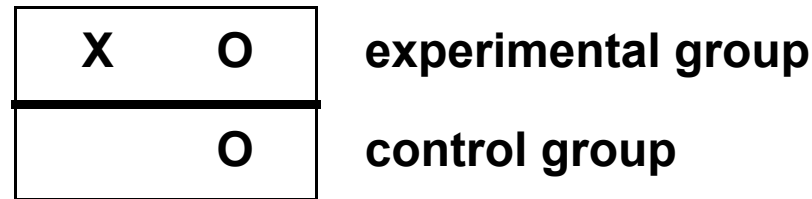
Most of the students are good ! ...

	x= ICT in school	x= no ICT in school	
bad at web search	10 students	???	• horizontal comparison of % ???
good at web search	20 students	???	

Things have changed ! ...

	before	after	
bad at web search	???	10 students	• horizontal comparison of % ???
good at web search	???	20 students	

Experiments without randomization nor pretest



 **There is no control over the conditions and the evolution of the control group**

- Example: Computer animations used in school A are the reason of better grade averages (than in school B)
- School A simply may attract pupils from different socio-economic conditions and that usually show better results.

The experiment without control group



 **We don't know if X is the real cause**

- Example: "Since I bought my daughter a lot of video games, she is much better at word processing "
- You don't know if this evolution is "natural" (kids always get better at word processing after using it a few times) or if she learnt it somewhere else.

2.4 Examples

Exemple 2-2: Under which conditions does animation favor learning ?

Master (DESS) thesis by Cyril Rebetez, TECFA 2005

Note: Funded by a real research project, i.e. the student did *more than usually expected* !

Research question

"Notre recherche a pour objectif de mettre en évidence l'influence, de la **continuité du flux**, de la **collaboration**, de la **permanence des états antérieurs**, ainsi que de vérifier la portée de **variables individuelles** telles que l'empan visuel et les capacités de rotation mentale."
(p.33)

- This objective is then further developed through 1 1/2 pages in the thesis. Causalities are discussed in verbal form (p. 34-40) and then "general" hypothesis are presented on 2 pages.

Explanatory (independent) variables, i.e. conditions

1. Animation, **static vs. dynamic condition**: allows to visualize transition between states. Static presentation forces a student to imagine movement of elements.
2. Permanence, **present or absent condition**: If older states of the animation are shown, students have better recall and therefore can more easily build up their model.
3. Collaboration, **present or absent condition**: Working together should allow students to create more sophisticated representations.

Operational hypothesis (presented in the methodology chapter):

Quotations from the thesis:

- Animation
 - Les scores d'inférence ainsi que les scores de rétention seront plus élevés en condition dynamique qu'en condition statique.
 - La charge cognitive perçue sera plus élevée en condition dynamique qu'en condition statique. Les temps de discussion ainsi que les niveaux de certitude n'ont pas de raison d'être différents entre les conditions.
- Permanence
 - Les participants en condition avec permanence auront de meilleurs résultats aux questionnaires que les participants en condition sans permanence. Les résultats d'inférence sont tout particulièrement visés par cet effet.
 - La charge cognitive perçue ne devrait pas être différente entre ces deux conditions. Les temps de discussion ainsi que les niveaux de certitude devraient être plus élevés avec que sans permanence.
 - L'influence de la permanence sera d'autant plus grande si les participants sont en condition de présentation dynamique.
- Collaboration
 - La collaboration aura un effet positif sur l'apprentissage, autant en ce qui concerne la rétention que l'inférence. Toutefois, l'inférence devrait être tout particulièrement avantagée en cas de "grounding". Les participants en duo auront donc de meilleurs scores que les participants en solo.
 - La charge cognitive perçue devrait suivre le niveau de résultat et être plus bas en condition duo qu'en solo.
 - Les temps de discussion devraient être naturellement plus grand en condition duo. Les niveaux de certitude devraient également s'élever en condition duo face à la condition solo.

Method (short summary !)

- Population = 160 students
 - All have been tested to check if they were novices (show lack of domain knowledge used in the material)
- Material
 - Pedagogical material is 2 different multimedia contents (geology and astronomy), each one in 2 versions. For the dynamic condition there are 12 animations, for the static conditions 12 static pictures
 - Contents of pedagogical material: "Transit of Venus" made with VRML, "Ocean and mountain building" made with Flash
 - These media were integrated in Authorware (to take measures and to ensure a consistent interface)
- Procedure (roughly, step by step)
 - Pretest (5 questions)
 - Introduction (briefing)
 - For solo condition: paper folding and Corsi visio-spatial tests
 - Material
 - Cognitive load test (nasa-tlx)
 - Post-test (17 questions)
- Measured dependant variables:
 - Nombre de réponses correctes aux questionnaires de rétention.
 - Nombre de réponses correctes aux questionnaires d'inférence.
 - Niveau de certitude des réponses aux questionnaires.
 - Scores sur cinq échelles de charge cognitive perçue (tirées du nasa-tlx).
 - Score au paper-folding test.
 - Score d'empan au test de Corsi.
 - Temps (sec) et nombre d'utilisation des vignettes en condition de permanence.
 - Temps de réflexion entre les présentations (sec).

3. Quasi-experimental designs

- are inspired by experimental design (pre- and post tests, and control groups)
- are led in non-experimental situations (e.g. real contexts)
- are used when the treatment is too "heavy", i.e. does not just involve a well defined variable
- address all sorts of threats to internal validity (see next slides)



In quasi-experimental situations, you really lack control

- you don't know all possible stimuli (causes not due to experimental conditions)
- you can't randomize (distribute evenly other intervening unknown stimuli over the groups)
- you may lack enough subjects

Usage examples in social sciences:

- evaluation research
- organizational innovation studies
- questionnaire design (think about control variables to test alternative hypothesis)

3.1 Interrupted time series design

O1	O2	O3	O4	X	O5	O6	O7	O8
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Advantages:

- you may control (natural) trends



Problems:

- Control of external simultaneous events (X_2 happens at the same time as X_1)
- Example: ICT-based pedagogies are introduced together with other pedagogical innovations. So which one does have an effect on overall performance ?

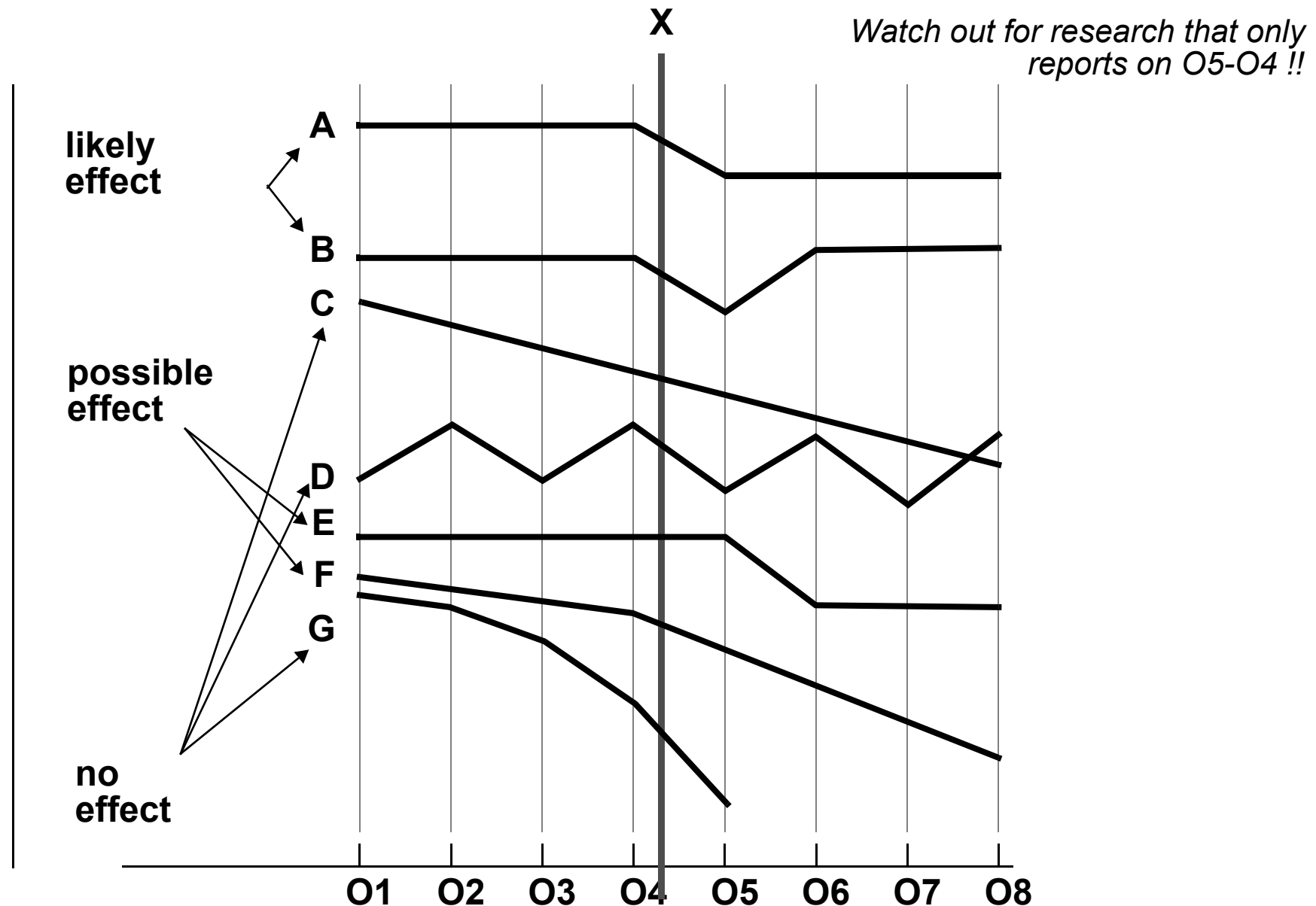


Practical difficulties

- Sometimes it is not possible to obtain data for past years
- Sometimes you don't have the time wait long enough (your research ends too early)
 - Example: ICT-based pedagogies often claim to improve meta-cognitive skills. Do you have tests for year-1, year-2, year-3 ? Can you wait for year+3 ?

Examples of time series (see next slide also):

- O1, O2, etc. are observation data (e.g. yearly), X is the treatment (intervention)



A. a statistical effect is likely

- Example "Student's drop-out rates are lower since we added forums to the e-learning content server "
- but attention: you don't know if there was an **other intervention** at the same time.

B. Likely "Straw fire" effect:

- Teaching has improved after we introduced X. But then, things **went back to normal**
- So there is an effect, but after a while the cause "wears out"
 - e.g. the typical motivation boost from ICT introduction in the curriculum may not last

C. Natural trend (unlikely effect),

- You can control this error by looking beyond O4 and O5 !

D. "Confusion between cycle effects and intervention"

- Example: government introduced measures to fight unemployment, but you don't know if they only "surf" on a natural business cycle. Control this by looking at the whole time series.

E. Delay effect:

- Example: high investments in education (take decades to take effect)

F. Trend acceleration effect,

- difficult to discriminate with G

G. Natural exponential evolution: same as (C).

3.2 Threats to internal validity

 What other variables could influence our experiments ?

(Campbell and Stanley, 1963)

Type	Definition:
history	An other event than X happens between measures example: ICT introduction happened at the same time as introduction of project-based teaching.
maturation	The object changed “naturally” between measures example: Did this course change your awareness of methodology or was it simply the fact that you started working on your master thesis.
testing	The measure had an effect on the object example: Your pre-intervention interviews had an effect on people (e.g. teachers changed behavior before you invited them to training sessions)
instrumentation	Method use to measure has changed example: Reading skills are defined differently. E.g. newer tests favor text understanding.
statistical regression	Differences would have evened out naturally example: School introduces new disciplinary measures after kids beat up a teacher. Maybe next year such events wouldn't have happened without any intervention.
(auto) selection	Subjects auto-select for treatment example: You introduce ICT-based new pedagogies and results are really good (Maybe only good teachers did participate in these experiments).

Type	Definition:
mortality	Subjects are not the same- example: A school introduces special measures to motivate "difficult kids". After 2-3 years drop-out rates improve. Maybe the school is situated in a area that show rapid socio-demographic change (different people).
interaction with selection	Combinatory effects example: the control group shows a different maturation
directional ambiguity	example: Do workers show better output in "flat-hierarchy" / participatory / ICT-supported organization or do such organizations attract more active and efficient people ?
Diffusion or treatment imitation	example: An academic unit promotes modern blended learning and attracts good students from a wide geographic area. A control unit also may profit from this effect.
Compensatory egalization	example: Subjects who don't receive treatment, react negatively.

3.3 Non-equivalent control group design

O_1	X	O_2	experimental group
O_3		O_4	control group



Advantages: Good at detecting other causes

- If $O_2 - O_1$ is similar to $O_4 - O_3$, we can reject the hypothesis that $O_2 - O_1$ is due to X.



Inconvenients and possible problems:

- Bad control of natural tendencies
- Finding equivalent groups and control interaction effects between groups may not be easy.

Exemple 3-1: Experimentation and imitation effects

	Course A introduces TEET	Course B doesn't	
Effect 1: costs	augment	stable	compare results horizontally
E 2: student satisfaction	augments	augments	
E 3: deadlines respected	better	stable	

Questions:

- E2: Why does student satisfaction improve at the same time for B ?

3.4 Validity in quasi-experimental design

Types of validity according to Stanley et al.



Internal validity concerns your research design

- You have to show that postulated causes are "real" (as discussed before), that alternative explanations are wrong.
- This is the most important validity type



External validity can you make generalizations ?

- not easy ! because you may not be aware of "helpful" variables, e.g. the "good teacher" you worked with or the fact that things were much easier in your private school
- How can you provide evidence that your successful ICT experiment will be successful in other similar situations, or situations not that similar ?



Statistical validity are your statistical relations significant ?

- not too difficult for simple analysis
- just make sure that you use the right statistics and believe them
- (see module on data analysis)



Construction validity ... are your operationalizations sound ?

- Did you get your dimensions right ?
- Do your indicators really measure what you want to know ?

Use comparative time series if you can

O	O	O	O	X	O	O	O	O
O	O	O	O		O	O	O	O

1. Compare between groups (situations)
2. Make series of pre- and post observations (tests)

Difficulties:

1. Find comparable groups
2. Find groups with more than just one or a few cases (!)
3. Find data (in time in particular)
4. Watch out for simultaneous interventions at point X.

Exemple 3-2: Michele Notari's master thesis

Title: Scripting Strategies In Computer Supported Collaborative Learning Environments

- This thesis concerns the design and effects of ICT-supported activity-based pedagogics in a normal classroom setting
- Target: Biology at high-school level (various subjects)

Three research questions formulated as 'working hypotheses':

- The use of a **Swiki** as collaborative editing tool **causes no technical** and comprehensive problems (after a short introduction) for high school students without experience in collaborative editing but with some knowledge of the use of a common text-editing software and the research of information in the Web.
- **Scripting which induces students to compare and comment on the work of the whole learning community** (using a collaborative editing tool) **leads to better learning performance** (as assessed by pre- and post-testing) **than a script leading students to work without such a tool and with little advice or / and opportunity to make comments and compare** their work with the learning community.
- The **quality** of the product of the working groups is **better** (longer and more detailed) when students are induced to compare and comment on their work (with a collaborative editing tool) during the learning unit.

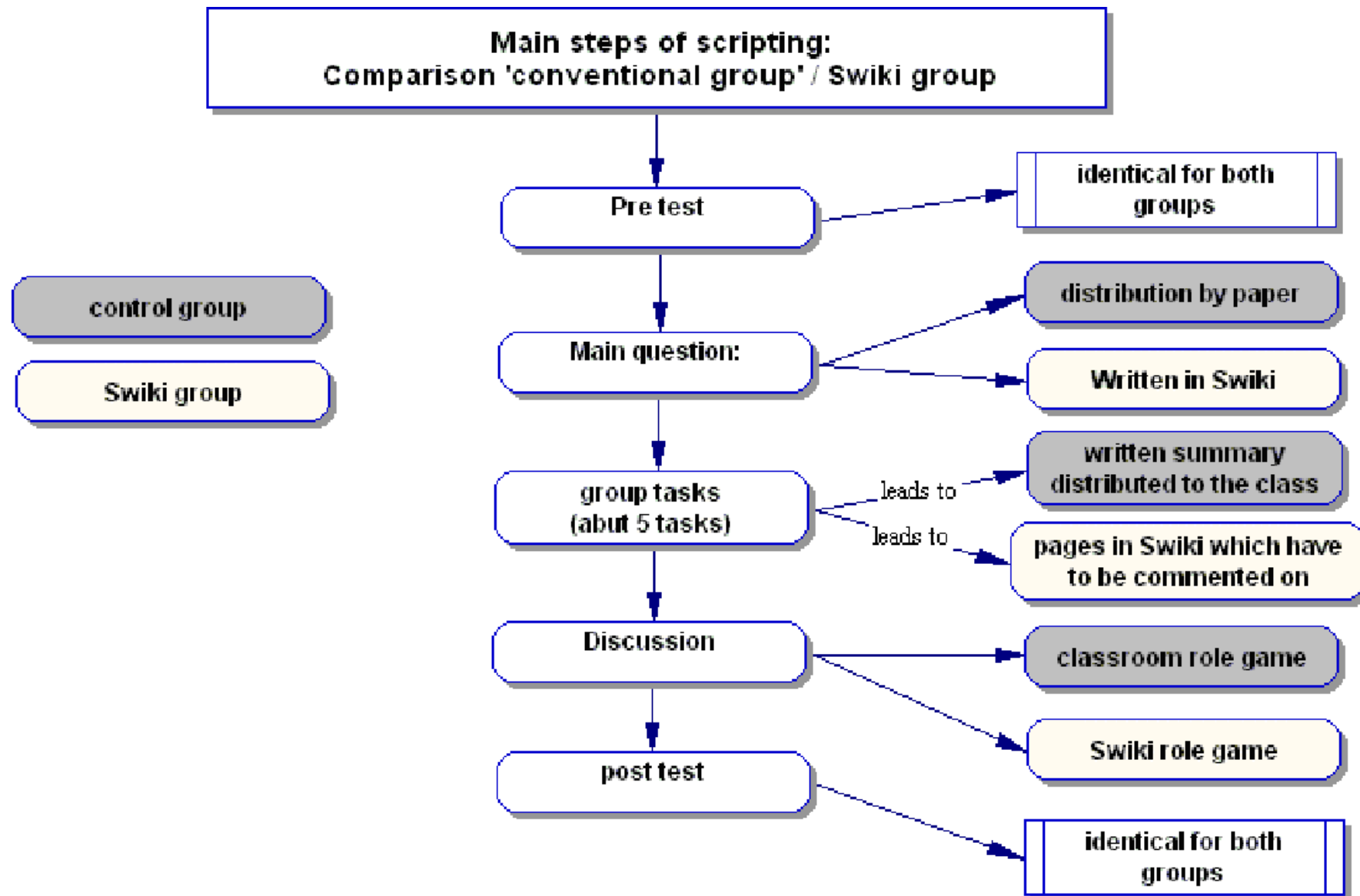
Method (Summary, quotations from thesis)

- The whole research took place in a normal curricular class environment. The classes were not aware of a special learning situation and a deeper evaluation of the output they produced.
- We tried to embed the scenarios in an absolutely everyday teaching situation and supposed students to have the same motivational state as in other lessons.
- To collect data we used questionnaires, observed students while working, and for one set up we asked students to write three tests.
- Of course the students asked about the purposes of the tests. We tried to motivate them to perform as well as they could without telling them the real reason of the tests.

Notes:

- This master theses concerns several quasi-experiments, all in real-world settings.
- On the next slide we just reproduce the settings for one of these.
- Several explaining variables intervene in the example on next page (the procedure as whole was evaluated, and not variables as defined by experimentalism).

A sample "experiment" from Notari's thesis:



4. Statistical designs

Statistical designs are related to experimental designs:

 **Statistical designs formulate laws**

- there is no interest in individual cases (unless something goes wrong)
- You can test quite a lot of laws (hypothesis) with statistical data (your computer will calculate)

 **Designs are based on prior theoretical reasoning, because:**

- measures are not all that reliable,
 - what people tell may not be what they do,
 - what you ask may not measure what you want to observe ...
- there is a statistical over-determination,
 - you can find correlations between a lot of things !
- you can not get an "inductive picture" by asking a few dozen closed questions.

 **Design à la Popper:**

1. You start by formulating hypothesis
(models that contain measurable variables and relations)
 2. You test relations with statistical tools
- Most popular variant in educational technology: Survey research

4.1 Introduction to survey research

A typical research plan looks like this:

1. Literature review leading to general research questions and/or analysis frameworks
2. You may use qualitative methodology to investigate new areas of study
3. Definition of hypothesis
4. Operationalization of hypothesis, e.g. definition of scales and related questionnaire items
5. Definition of the mother population
6. Sampling strategies
7. Identification of analysis methods

Implementation (mise en oeuvre)

1. Questionnaire building (preferably with input from published scales)
2. Test of the questionnaire with 2-3 subjects
3. Survey (interviews, on-line or written)
4. Coding and data verification + scale construction
5. Analysis

Writing it up

- Compare results to theory
- Marry good practise of results presentation and discussion, but also make it readable

4.2 Levels of reasoning within a statistical approach

Reasoning level	Variables	cases	Relations (causes)
theoretical	concept / category	depends on the scope of your theory	verbal
hypothesis	variables and values (attributes)	mother population (students, schools,)	clearly stated causalities or co-occurrences
operationalization	dimensions and indicators	good enough sampling	statistical relations between statistical variables (e.g. composite scales, socio-demographic variables)
measure	observed indicators (e.g. survey questions)	subjects in the sample	
statistics	measures (e.g. response items to questions) scales (composite measures)	data (numeric variables)	

(Just for your information. If it looks too complicated, ignore)

4.3 Typology of internal validity errors



Error of type 1: you believe that a statistical relation is meaningful

... but "in reality" it doesn't exist

- In complicated words : You wrongly reject the null hypothesis (no link between variables)



Error of type 2: you believe that a relation does not exist

... but "in reality" it does

- E.g. you compute a correlation coefficient, results show that is very weak. Maybe because the relation was non-linear, or because an other variable causes an interaction effect ...
- In complicated words: You wrongly accept the null hypothesis



The are useful statistical methods to diminish the risks

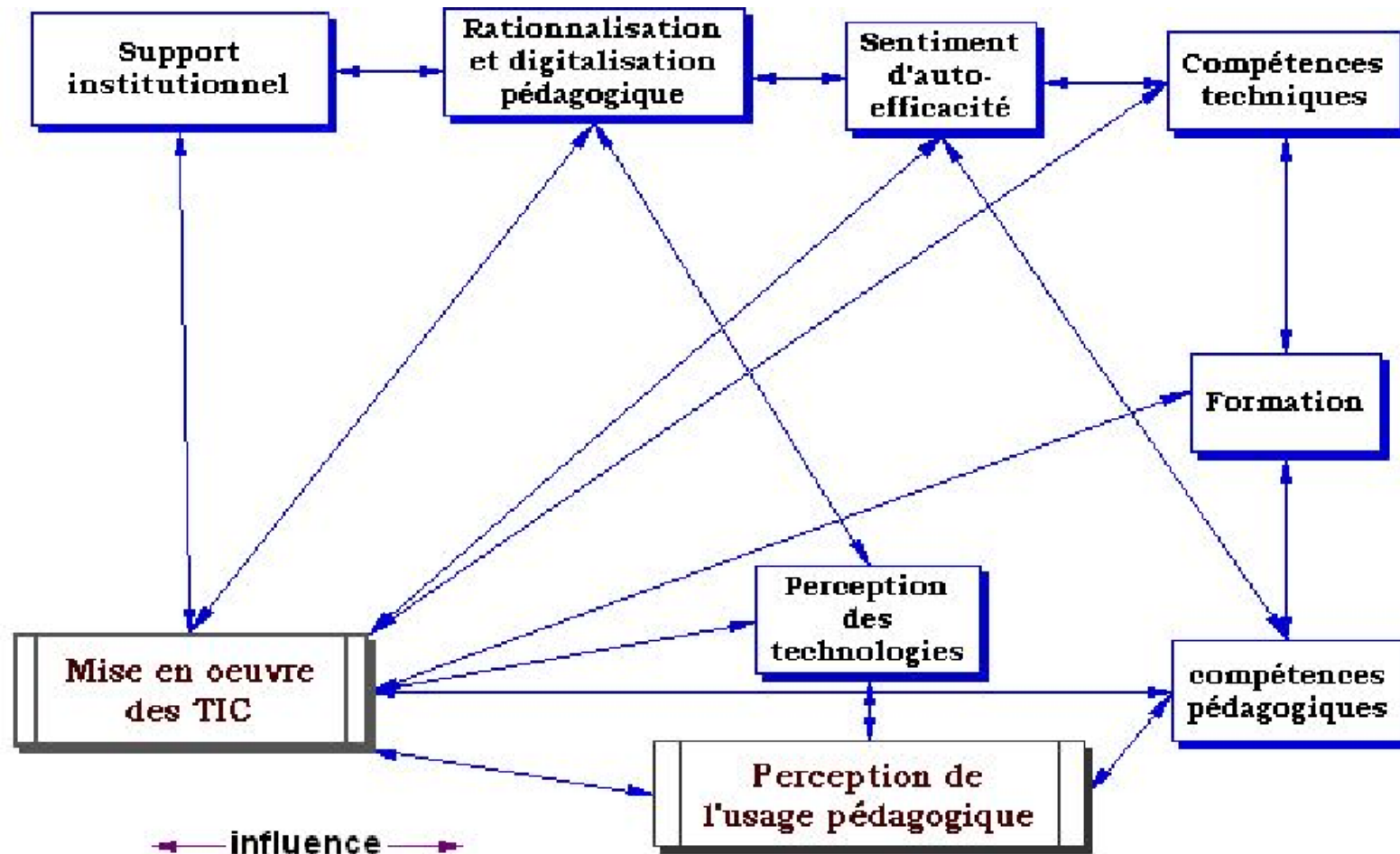
- See statistical data analysis techniques
- Think !

4.4 Survey research examples

- see also quantitative data gathering and quantitative analysis modules for some examples

Exemple 4-1: Etude pilote sur la mise en oeuvre et les perceptions des TIC

- (Luis Gonzalez, DESS thesis 2004): Main goal: "Study factors that favor teacher's use of ICT". The author defines 8 factors and also postulates a few relationships among them



- Below we quote from the thesis (and not the research plan):

<< Mon hypothèse principale postule l'existence d'une corrélation entre les facteurs suivants et la mise en œuvre des TIC par les enseignants :

- Le **type de support** offert par le cadre institutionnel
- Leurs **compétences pédagogiques**
- Leurs **compétences techniques**
- La **formation reçue**, que se soit la formation de base ou la formation continue
- Leur **sentiment d'auto-efficacité**
- Leur **perception des technologies**
- Leur **perception de l'usage pédagogique** des TIC
- Leur rationalisation et **digitalisation pédagogique**

Mes hypothèses secondaires sont :

1. La perception de l'usage péd. est corrélée avec les compétences pédagogiques de l'enseignant.
2. La perception des technologies est corrélée avec celle de l'usage pédagogique.
3. Rationalisation et digitalisation péd. est corrélée avec la perception des technologies.
4. La formation est corrélée avec les compétences pédagogiques et techniques.
5. Le sentiment d'auto-efficacité est corrélé avec les compétences pédagogiques et techniques.
6. Rationalisation et de digitalisation péd. est corrélée avec le sentiment d'auto-efficacité." >>

Sampling method

- Representative sample of future primary teachers (students), N = 48
- Non-representative sample of primary teacher's, N = 38
 - All teachers with an email address in Geneva were contacted, auto-selection (!)
 - Note: the questionnaire was very long, some teachers who started doing it, dropped out after a while
- This sort of sampling is ok for a pilot study

Questionnaire design

- Definition of each "conceptual domain" (see above, i.e. main factors/variables identified from the literature).
- Create item sets (questions). Scales have been adapted from the literature if possible
 - L'échelle d'auto-efficacité (Dussault, Villeneuve & Deaudelin, 2001)
 - Enquête internationale sur les attitudes, représentations et pratiques des étudiantes et étudiants en formation à la profession enseignante au regard du matériel pédagogique ou didactique, informatisé ou non (Larose, Peraya, Karsenti, Lenoir & Breton, 2000)
 - Guide et instruments pour évaluer la situation d'une école en matière d'intégration des TIC (Basque, Chomienne & Rocheleau, 1998).
 - Les usages des TIC dans les IUFM : état des lieux et pratiques pédagogiques (IUFM, 2003).
- Collect data with an on-line questionnaire (using the ESP program)
- Purification of the instrument. For each item set, a factor analysis was performed and indicators were constructed according to auto-correlation of items (typically the first 2-3 factors were used).
 - Note: If you used fully tested published scales, you don't need to do this !

Example regarding the concept "perception of pedagogical ICT use"

- In the questionnaire this concept is measured by two **questions sets** (scales).
<< La perception de l'usage pédagogique des TIC comporte deux séries de questions s'intéressant respectivement au degré d'accord des enseignants avec les discours gouvernementaux et scientifiques sur le recours aux ressources éducatives informatisées en éducation (question 34, 10 items) et au degré d'importance accordé à diverses ressources informatisées (question 43, 12 items). >>

Here we show one of these 2 question sets:

Question 34. PUP1: Les énoncés suivants reflètent des opinions " fort présentes " dans les discours gouvernementaux ainsi que " scientifiques " qui portent sur le recours aux ressources éducatives informatisées en éducation. Indiquez votre degré d'accord par rapport à chacun d'entre eux.

(Tout à fait en désaccord=1 Plutôt en désaccord=2 Plutôt d'accord=3 Tout à fait d'accord=4

	1	2	3	4
Pour l'élève, le recours aux ressources de réseau favorise l'autonomie dans l'apprentissage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Faire communiquer les élèves entre eux grâce à la télématique rend l'apprentissage collaboratif.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utiliser des ressources éducatives informatisées à l'école favorise le développement de la créativité chez l'élève.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utiliser les ressources de réseau favorise les scénarios d'apprentissage de type constructiviste.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Naviguer sur l'Internet contribue fortement à développer des compétences méthodologiques indispensables à l'apprentissage scolaire.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Faire partager par les élèves les postes de travail disponibles en classe favorise le travail collaboratif.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apprendre dans un environnement informatique motive les élèves.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recourir aux ressources éducatives informatisées est surtout utile pour soutenir l'apprentissage des matières de base.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utiliser les TIC et les ressources éducatives informatisées constitue généralement une innovation pédagogique.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
L'enseignement par projet est facilité par les TIC.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Note: these 10 items and the 12 items from question 43 have been later reduced to 3 indicators:

Var_PUP1 Degré d'importance des outils d'entraide et de collaboration pour les élèves


Var_PUP2 Degré d'importance des outils de communication entre élèves

Var_PUP3 Accord sur ce qui favorise les apprentissages de type constructiviste

5. Similar comparative systems design

Principle

 **Make sure to have good variance within “operative variables” (dependant + independent)**

 **Make sure that no other variable shows variance (i.e. that there are no hidden control variables that may produce effects)**


$$\frac{\text{variance of operative variables}}{\text{variance of control variables}} = \text{maximum}$$

In more simple words: Select cases that are different in respect to the variables that are of interest to your research, but otherwise similar in all other respects.

E.g. don't select an prestige school that does ICT and a normal school that doesn't do ICT if you want to measure the effect of ICT. Either stick to prestige schools or "normal" schools, otherwise, you can't tell if it was ICT that made the difference ...

Advantages and inconvenients of this method

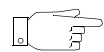
 less reliability and construction validity problems

 better control of "unknown" variables

 worse external validity (possibility to generalize)

6. Summary of theory-driven designs discussed

approach	some usages
2. "Experimental designs" [3]	<ul style="list-style-type: none"> • Psycho-pedagogical investigations • User-interface design
3. "Quasi-experimental designs" [12]	<ul style="list-style-type: none"> • Instructional designs (as a whole) • Social psychology • Public policy analysis • Educational reform • Organizational reform
4. "Statistical designs" [24]	<ul style="list-style-type: none"> • Teaching practise • Usage patterns
5. "Similar comparative systems design" [32]	<ul style="list-style-type: none"> • Public policy analysis • Comparative education



Of course, you can combine these approaches within a research project. You even can use combinations to triangulate answers for a single research question.

