The role of scientific research in educational interventions

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Introduction

This module aims to introduce students to some important issues related to the incorporation of professional competence in research as a key instrument for promoting quality in educational interventions. Taking the professional debates that have dealt with this issue during the last two decades as a starting point, we will explore the internal and external tensions that have led to the fact that educational research has taken the research conducted in the field of medicine as a reference. In this sense, this discussion will serve to challenge the notion that the research conducted in experimental settings and particularly, tests or *randomised controlled trials* (RCTs) must necessarily be the standard of reference for educational research and therefore be able to recognise the opportunities that the various available research methods can offer in providing the rationale and evaluation of educational interventions.

To do this, we will now present a brief approach to the scientific method which, beyond its canonical phases, will allow us to understand research as a cyclical or iterative process in which the various procedures available have in common the collection and systematic analysis of the data obtained, with the aim of improving our understanding of the phenomena under study. This approach will serve us later in addressing the results produced by this complex process; in other words, the scientific evidence that it is able to provide as a guarantee that the knowledge generated is in fact in line with what happens with the phenomena. As a result of the pragmatic approach adopted in this text, we will present general principles aimed at promoting quality in the development of the different research phases, a necessary but insufficient condition for assessing the strength or sufficiency of the evidence obtained to answer the research question.

Finally, we will put this discussion into play based on an example that will serve to illustrate the different types of research validity and that it is, in fact, difficult to meet all the requirements in a single investigation. In this sense, we will highlight the shared nature of the challenge posed by the joint construction of an improvement in the understanding of phenomena based on the accumulation of scientific evidence obtained in several independent investigations that supports the new knowledge generated. Finally, we will offer an annotated bibliography with some interesting references that may be useful for furthering the development of research competence beyond the limitations of this text.

1. The importance of professional competence in educational research

In general terms, we can define education as the process by which the acquisition of knowledge, skills and values in people who are part of a certain society is promoted. In this sense, as a human activity, education is based on the development of two fundamental practices, teaching and learning, in a more or less organised manner, which form part of the daily life of all societies for which, in historical terms, we have proof. Although it is not our responsibility here to explain the history of education, it is important to bear in mind the long shadow cast by the daily practices on which this process is based and, even more so, the ultimate objective pursued by education so that it can be placed within the scope of professional practice. We teach, but we also learn, to improve opportunities in people's lives, and it is in this sense that societies establish artificial systems to guarantee their own progress by improving the living conditions of the individuals that make up these societies. This idea of contributing to the common good, however, is not only crucial in understanding the professional practice of education as an essential public service, but, as we will see below, it also introduces the need to articulate competence in research as a key instrument in promoting quality in educational interventions.

Education as a basic right of people

Although we do not hesitate to think of education as a fundamental right nowadays, it is interesting to remember that it was not explicitly recognised as such until 1948, the year in which the General Assembly of the United Nations adopted the Universal Declaration of Human Rights. Article 26 specifies, among other things, the mandate to make education accessible and free of charge, at least in the initial stages, which should always be aimed at the development of people.

Although the discussion about the education process is an issue that has occupied many thinkers throughout history, it was not until the constitution and, in particular, the universalisation of schools as educational institutions that we could recognise the context in which education professionals began to develop their role as we know it today. While it is true that the idea of grouping students and structuring their learning has its origins in ancient times, the establishment of modern educational systems from the 18TH century, and particularly the adoption of compulsory schooling to ensure access to education for the entire population, led to the development of a context in which, from the 19TH century, and especially the 20TH century, the professional educational practice was provided with the necessary tools to reflect on its own practices. Among others, the constitution of Pedagogy as an academic discipline, the articulation of the different trends in teaching and learning that we have today, the evolution of formal systems beyond the obligation to promote lifelong education and recognition of the importance of non-formal contexts as valuable educational spaces, shaped a rich and diverse professional field in which a multitude of professionals from different disciplines are involved.

In this context, education professionals have not only specialised to deal with the different areas of intervention in which they work, but have also embraced the requirement of justifying and evaluating their own practices so as to try to develop them in the best possible way. If education is one of the most im-

portant tools of societies to progress in improving the living conditions of its members, it is not surprising that during the last few decades public interest has grown stronger on this issue which, in practice, has translated into a demand for transparency and accountability from the professionals involved. In this sense, it is not only expected that educators justify the teaching and learning practices they promote in the best possible way, but that they do so in accordance with the knowledge generated in the framework of scientific research. As has happened in other professional fields, the time when decisions were based on intuitions, beliefs or personal convictions has long gone. By contrast, there is a great consensus regarding the need for responsible actions that aspire to use, whenever possible, the methods and procedures supported by their outcomes and that, ultimately, educational interventions are also subject to scrutiny and systematic analysis that allow their evaluation.

It is important to bear in mind however, that there are many tensions to which educational research has been, and still is, subjected to, especially when it is used in the search for quality in the professional intervention. On the one hand, in terms of internal debates within the field of education, it is still possible to find some resistance that calls for distance between the professional world and the academic world, the difficulty of applying scientific knowledge in specific situations and the excessive focus on the results of interventions, while ignoring the importance that understanding the processes involved also provides for them to be achieved. On the other hand, taking into account the external pressures that have been caused by other areas, it is not difficult to find discourses that affirm that educational research has a nature that is excessively applied which limits the possibility of generalising the outcomes for other contexts, that does not always achieve the quality criteria demanded in other disciplines and that even the investigations that are carried out are not relevant for addressing the "real" problems in education or, when they are, they are still conditioned by a high ideological component. Many of these criticisms, however, often share a certain understanding of what educational research is or should be that should be borne in mind.

The extent of a profession based on the accumulation of evidence

A good way of understanding the debates around the role of research in the professional practice of education is by understanding its roots. In this sense, one of the authors who focused on the critical aspects of the discussion was David Hargreaves (1996) who, two decades ago, called for the need to transform the profession by incorporating the process of scientific research for the purpose of improving educational practices as medicine had done. See also Davies (1999) for a similar approach: making the same parallel with the field of medicine emphasises the need to carry out a systematic evaluation of the available evidence to adequately justify educational interventions.

Indeed, both internal and external debates regarding the role of research in education are often based on a comparison that, although biased, has not stopped gaining ground in the shared imagination of what educational research should be. If education, as an area of professional intervention, must be based on scientific research in order to justify and evaluate its practices, it should do so by following the norms established by other disciplines and, particularly, those that characterise the ones developed in the field of medicine. This idea, highly restrictive and characterised by a positivist vision in relation to scientific knowledge, assumes that the quality of research is intrinsically linked to the method used to conduct it. According to this approach, the ideal research would match that produced in purely experimental settings and particularly using *randomised controlled trials* (RCTs). With a markedly quantitative approach, this type of research is characterised by strict control over the administration of the different treatments to the participants, so that the recipients are randomly assigned to the different experimental conditions with the aim of making the groups comparable. Only when a certain intervention has been tested in a controlled clinical trial of this type are its effects considered to have really been proven.

"Why education experts resist effective practices (and what would it take to make education more like medicine)"

With this provocative title, the report by Carnine (2000) is a good example for illustrating that the debate about the professional practice of education has not only been influenced by the contempt towards their own practices but that, often, they have placed their hopes for change in the external pressure that other fields of knowledge have exerted upon it. In order to become a mature profession, education should follow the example of medicine and, therefore, adopt experimental research as a reference of quality.

What works in education?

Another important author in the debate on the role of educational research is Robert Slavin (2002 and 2008), defender of a strong position on the necessary relationship between research methods and the quality of the evidence that they provide which, ultimately, leads him to favour experimental research and the summary of the results it provides through the development of meta-analysis as the only way of advancing knowledge in this field. See also Olson (2004) and Chatterji (2008) to find an alternative view to this approach.

Although the possible variants from this general approach are very diverse, the truth is that this idea considers this method as the *gold standard* in the context of medical research and therefore, it would become a priority for any type of research, including the research that takes place in the field of education. The problem with these types of randomised controlled trials, however, is not only the difficulty in applying them in the contexts in which the educational professionals intervene but, moreover, in the fact that they are not necessarily the most appropriate for any kind of research question. In this sense, this procedure is optimal for obtaining evidence to determine the existence of causal relationships to the extent that it enables the effect of any other external factor to be controlled and, as such, should not be ruled out in any field of research. But that does not make it the only possible method, or one which that be favoured ahead of other available methods. Trying to determine what works by comparing different interventions is not the same as attempting to explain the reasons why it does so. However, even assuming that this was the objective of the research, there are other considerations that must be taken into account in the field of education.

The secondary role of non-experimental research

This position, championed by Torgerson and Torgerson (2001 and 2008) as the main supporters of defining the experiment as a gold standard, highlights the prevalence of the positivist view where it is only randomisation that will be able to provide the necessary evidence to respond to all the important questions for developing knowledge in the field of education. See also Hanley, Chambers and Haslam (2016) for a recent critical discussion on the consideration of the other available methods and, therefore, the evidence they provide, as inferior forms of the research process.

As will be evident to students, education professionals work with materials and circumstances that are significantly different from those who work in medical practice. On the one hand, teaching and learning practices are not a cure for

any disease that can be diagnosed from a set of clearly defined signs and symptoms that have a known biological cause and evolution and which, therefore, require a treatment. On the other hand, the professional practice of education generally occurs in environments that have little to do with standardisation that promotes the adoption of the multiplicity of protocols that structure the activity of health personnel and the passage of people through their hands. Also, the understanding of educational intervention can hardly be compared with the administration of a specific treatment such as a medicine, in which the composition and chemical properties and, moreover, the procedure and dosage necessary for it to have the expected effects can be known with certainty. Finally, with regard to the evaluation of the results obtained once the educational intervention has been carried out, the fact that it may or may not be possible to verify an improvement in teaching and learning practices is hardly comparable to the mitigation or cure of symptoms which, ultimately, are proposed by medical professionals.

However, even if we were still in a position to find a certain parallel between these two areas of intervention, what is even more important is that the diversity of problems, contexts, actors involved and resources with which education professionals operate, often make it difficult to comply with the requirements of experimental research and, particularly, randomised controlled trials that would represent the ideal of medical research so as to be able to conduct them with all the guarantees. In this sense, the contingency that characterises the way in which improvements in teaching and learning practices are finally implemented often makes it very complicated when comparing two or more educational interventions carried out in different settings, or even at different times, no matter how much they all share the same foundation. Also, it is not common for education professionals to use more than one type of intervention to make comparisons based on their success and, in any case, it is often particularly difficult to include the condition that some of the participants do not receive any and, as such, constitutes a control group. Moreover, assuming that all this is really possible, practical or ethical limitations may, despite the fact that the research question is pertinent and relevant, advise against there being a random assignment of participants to the different experimental conditions.

Myths about experimental research

By recognising that randomised controlled trials are not, in any case, the most appropriate methodology for answering any type of research question and, therefore, that the quality of the evidence that can be obtained from this process is not necessarily conditioned by the methodology used, the discussion by Goldacre (2013) is interesting in order to be able to assess to what extent the practical and ethical limitations that are often claimed against the use of experiments in the field of education are, in fact, applicable to all situations.

As a consequence of all this, it is not only necessary to question the idea that randomised controlled trials promoted in the field of medicine should be the standard of reference for educational research, but also that we should be able to recognise the opportunities offered to us by the set of research methods available. It is precisely for this reason that, if education professionals must base and evaluate their own practices to try to develop them in the best possible way and thereby contribute to the common good, research competence becomes a key instrument for promoting the quality of the interventions in the different areas they are dealing with. In this sense, as we will see below, the

first step for the acquisition and development of this professional competence is understanding the characteristics and particularities of scientific research as a general procedure for producing knowledge.

2. A brief approach to the scientific research process

There are different ways of obtaining new knowledge about the world in which we live and about the phenomena that surround us in our daily activity. In an intuitive way, it is possible to describe some practices that, in one way or another, can be recognised by the way we relate to everything we want to understand. So, for example, sometimes we appeal to others to provide us with what they know, accepting and making new knowledge about what we want to understand our own, thanks to the trust we have in them. Either because we think that it must necessarily be true, as would be the case with beliefs or faith, or because we assume that this depends on the prestige or reputation of the people, as would be the case of knowledge based on authority; this way of understanding or explaining the phenomena that surround us is characterised by the fact that, as receivers, we are not direct participants, and we cannot become so if we propose it, of the process by which knowledge has been developed or constructed. Beyond the negative consequences that have emerged throughout history and that, in fact, still occur, this way of obtaining new knowledge about whatever we are interested in learning makes it very difficult to differentiate what, in reality, would be opinions, prejudices or false beliefs precisely because they cannot be testable or verifiable.

On the other hand, at other times, we assume an active role in the creation of new knowledge based on our own reasoning. This is the case, for example, with the use of the deduction process where, taking one or more premises as a starting point, we can reach a conclusion that will be true as long as we respect the rules of logic and that the starting premises are also true. Starting from general categories, this way of obtaining new knowledge allows us to draw conclusions about the particular cases that interest us without the need to have a direct experience. In contrast to this course of action, the induction process is a second way of participating in the generation of new knowledge where, based on our direct experience with phenomena, we use the results of our observations to arrive at a conclusion that, to a greater or lesser degree, will also be true. Unlike the process of deduction, this type of reasoning does not require that the premises derived from the experience with the phenomena we want to know are necessarily true; however, the strength or sufficiency of the proof or evidence that we obtain from the particular cases, which serve as a starting point, will determine to what extent the conclusion we reach may end up being accepted as true.

Finally, and what interests us in this manual, it is possible to identify a final way of obtaining new knowledge: the scientific method. Generally understood as a combination of the processes of deductive and inductive reasoning as has been explained above, the scientific method was developed in the context of experimental research as a rigid sequence of steps that can be briefly characterised in the following way. Firstly, the generation of new scientific knowledge begins with an observation of the phenomena that we propose to understand; this, according to the induction process, leads us to offer a tentative explanation. Whether as a product of mere observation from our direct experience, or from knowledge established in a theory previously developed following the scientific method, this tentative explanation leads us to formulate a hypothesis that, according to the process of deduction, now allows us to develop one or more predictions that can then be tested through experimentation. In this sense, the observation of the phenomena that we want to learn about in a controlled environment serves to collect information in an organised and systematic way that, once analysed, allows us to determine to what extent the results are coherent with the predictions derived from the initial hypothesis. Finally, the strength or sufficiency of the proof or evidence obtained through experimentation leads to the acceptance or rejection of this hypothesis and, again using the induction process, the conclusion we have reached serves to generate new knowledge from which it will be possible to develop new theories, confirming or refuting them.

A process based on logical reasoning from evidence

As we will see later, what gives special value to scientific research as a way of obtaining new knowledge is the way in which it enables us to make inferences about the phenomena we want to understand, as well as determining to what extent these inferences are acceptable, by combining the rules of logic and the results of observation from our direct experience with them.

The role of manipulation in experimentation

According to this formulation of the scientific method, the key to determining the existence of causal relationships is based on the capacity of experimental research to obtain evidence from the consequences of manipulation in a controlled environment, in accordance with our will, of the phenomena concerned. In this way the results provided by the experiments serve to test the predictions derived from the initial hypothesis.

The scientific method, understood as a certain way of obtaining knowledge, is not really a single method. Beyond the canonical definition of its phases, we have different procedures for carrying it out, but all of them have in common that scientific research is always characterised as being a cyclical or iterative process in which the collection and systematic analysis of the data obtained allow us to improve our understanding of the phenomena that we are aiming to understand.

In this sense, the markedly empirical nature of the scientific method also has some important implications that differentiate it from the other ways of obtaining knowledge, based on trust in others. On the one hand, the conclusions of any investigation must always be accompanied by the proof or evidence that can justify it, even provisionally, to ensure that the new knowledge generated is consistent with what actually happens with the phenomena we want to learn about. On the other, it is also essential that the proof or evidence provided as a result of this process is presented together with a clear and detailed description of the procedures carried out to obtain it, so that they can be verified by other people and, ultimately, can be reproduced independently to verify that they have been correctly developed and that they have not been subject to error.

This particular way of advancing scientific knowledge, where the results of research provide new hard evidence to refine it, makes it possible, at least ideally, to describe research as a systematic process of continuous improvement that continuously feeds back on itself and has the necessary mechanisms to self-correct thanks to the transparency of its procedures. This does not imply, however, that it is possible to grant a value of absolute certainty to the knowledge obtained through the scientific method. On the contrary, it should always be borne in mind that certainty depends not only on the strength or sufficiency of the proof or evidence on which the knowledge is based, which will make it more or less reliable, but that obtaining new proof or evidence can lead to the scientific knowledge being questioned, modified or even dismissed. In addition, this way of obtaining new knowledge adds some important assumptions regarding the type of phenomena that, in fact, can be approached with the scientific method. As will be evident to students, this way of proceeding implies that it is only possible to obtain scientific knowledge about those things that are essentially regular; in other words, that respond to a certain order, and that this order must also have the ability to be empirically discovered and contrasted. If this were not the case, the phenomena would simply be excluded from the possibility of being addressed through the scientific research process.

The importance of observational research in natural contexts

Although experimental research is the alternative of choice when we aim to obtain evidence to provide the necessary guarantees about the existence of causal relationships in controlled environments, the truth is that not all research questions require an answer like this. On the contrary, non-experimental or observational research allows us to obtain equally interesting evidence about the circumstances in which these relationships occur in their natural contexts and, therefore, to have the necessary guarantees on their generalisation of other people, different contexts or moments.

Although, as we said, there is not really a single way of meeting the requirements of the scientific method, the truth is that the great diversity of phenomena that can be addressed through the process of scientific research has led to the specialisation and improvement of procedures that we have at our disposal to meet the specificities in different areas of knowledge. However, for didactic reasons, it is common for the explanation of these procedures to be organised based on some classifications that, up to a certain point, are artificial in nature. Thus, on the one hand, a distinction is often made between basic and applied research when taking into account its purpose. However, this dichotomy is difficult to apply in practice, since almost all research is proposed, to a greater or lesser degree, both to obtain new knowledge about the phenomena that serves to generate some theory about them and so that this new knowledge can be used in some way for solving an applied problem. On the other hand, it is common to differentiate between quantitative and qualitative research when taking into account the type of information they use. To some extent, this distinction is also problematic since all quantitative research in some way involves some kind of qualitative judgement, just as all qualitative research also involves some type of quantitative judgement. In fact, the difficulty of maintaining this dichotomy has led to the development, in recent decades, of an alternative mixed approach based on the combination of both types of data.

Beyond the usefulness of these two classifications for imposing a sense of order in the multitude of practices with which the process of scientific research is carried out, it is important to keep in mind that their use often responds to a value judgement that more or less explicitly expresses a preference for a certain type of research. Given the diversity of procedures available for advancing knowledge in different areas, this vision favours basic research, given that its ultimate purpose would be the development of theories, which adopts a quantitative approach in the analysis of data obtained in experimental settings. In this sense, it places the hypothesis building and testing as an essential element of the research and defines its quality as the necessary consequence of strictly observing each and every one of the canonical phases with which the scientific method was originally characterised. The reality of scientific research, however, has been evolving over time; so depending on the field of knowledge it is possible to find quantitative research that is not based on experiments or that does not even pose hypotheses, as well as qualitative research that has taken them as a starting point but, obviously, does not comply with the control conditions required by experimentation. These decisions, in fact, usually have more to do with the degree of development and strength of the different fields of knowledge and, therefore, with having well-founded or not-so-well-founded theories for analysing the phenomena of interest.

Beyond the distinction between quantitative and qualitative

After many decades of bitter debate between the supporters of quantitative and qualitative research, the emergence of a mixed approach helped to highlight the need to adopt a pragmatic view of the research process where the recognition of the virtues and limitations of both methods have given way, whenever the question permits, to the articulation of their results in the same investigation as a strategy for obtaining more complex answers. Interested students can find a good review of the issue in Bryman's (2012) chapter on breaking down the quantitative and qualitative division.

Regarding the role of randomised controlled trials in the field of educational research, this supposed standard of reference is not always the best choice when we consider the different types of questions that can be posed, but that, even when it is, it is often very difficult to comply with the requirements established by experimental research in practice. For this reason, the debate over the quality of scientific research has led, during recent decades, to the emergence of a pragmatic approach that can adapt it to the complexity and diversity of problems that are particularly proposed for addressing social sciences. This approach, which we assume and make our own in this text, shifts the focus of the scientific method's constituent elements as originally conceived towards the follow-up of some general principles with which it is essential to guide the practices and procedures that characterise scientific research. In this sense, this pragmatic approach explicitly recognises the contingency with which this process must be carried out in the different areas of knowledge and, therefore, gives value to the decisions that can be made the way in which it is conducted and its appropriate justification as determinants of the quality of the results that can be obtained in practice.

This brief approach to the process of scientific research as a general procedure for generating knowledge has served to highlight the fact that, although we often speak of the scientific method as if it were a single method, in reality there are many, very diverse procedures and practices that fit with its general logic and that, therefore, allow its requirements to be met. For this reason, as we said before, education professionals who intend to incorporate research competence as an instrument for the promotion of the quality of interventions in the different areas they deal with should be able to recognise the op-

portunities that the different methods available offer them. With this recognition, however, it is not enough. As we will see below, the second step for the acquisition and development of this professional competence is understanding the value of the results provided by scientific research.

3. The value of scientific evidence in helping the educational intervention

The consideration of scientific research as a cyclical or iterative process in which the systematic collection and analysis of the data obtained allow us to improve our understanding of the phenomena that we have proposed to understand not only reveals the empirical nature of this way of obtaining new knowledge, but puts forward the relevance of the results it provides to be able to do so. As we said, beyond the diversity of methods available to carry it out, scientific research advances knowledge thanks to the proof or evidence it is able to obtain to support its conclusions and, in this way, offers a certain guarantee that the knowledge generated is in line with what really happens with the phenomena we want to learn about. This proof or evidence is what, in this manual, we call scientific evidence that, as we will see below, plays a key role in helping the foundation and evaluation of educational interventions. Before continuing, however, it is important that we address a small terminological consideration.

A broader vision of scientific evidence

As a result of how this term has been used in the field of education, often linked to the intrinsically superior value of experimental research, some authors have opposed its use as a type of resistance. This is the case, for example, for Biest (2007 and 2010), with whom we share the critical approach but not the need to abandon the term; on the contrary, the convenience of giving it a different meaning that highlights the value of the results that, in a complementary way, can be offered by the different research methods. See also Eryaman and Schneider (2017) for a recent discussion on this issue.

On the one hand, with the term *evidence* we refer to the fact that the results obtained through the process of scientific research are nothing other than to support, even if provisionally, the new knowledge that it generates. On the other hand, we use the word *evidence* as an uncountable noun to reflect that an investigation rarely focuses its efforts on providing one single piece of evidence and that, in any case, there is never a single piece; rather, it is an accumulation of a set of evidence obtained in several independent investigations which really enables the advancement of knowledge held regarding the phenomena in the different areas. This use, however, does not fully correspond with the rather restrictive interpretation that has been made of this term in the field of medicine and that, generally, accompanies it even when it is used in other fields such as education.

As a result of the privilege of experimental research, and particularly of randomised controlled trials that represent the standard of reference in medical research, this view assumes that the quality of the evidence obtained is always a necessary consequence of the method used to obtain it. On the contrary, as it derives from the pragmatic approach that we have adopted in this text, it is only possible to guarantee the quality of scientific evidence from the adoption of some basic principles that can guide the development of practices and procedures that characterise each of the methods available.

The importance of reviewing the available evidence

If scientific knowledge is the result of a cyclical or iterative process in which the conclusions of different investigations provide new hard evidence to refine it, improving our understanding of phenomena not only requires us to launch new investigations, but always requires us to do so by following on from the results that others have obtained before. In this sense, we have some structured procedures, such as systematic reviews (Gough, Oliver and Thomas, 2017), where it is possible to collect, evaluate and synthesise the evidence and, in this way, obtain a more complete view of the phenomena, observe inconsistencies between investigations, better interpret the results of a particular investigation and detect new opportunities to expand on them. See also Gough and Thomas (2016) for a specific discussion on the role of systematic reviews in the field of education.

Although they do not have to be specific to educational research, these general principles are especially relevant for all education professionals who intend to incorporate research competence in response to the need to justify and evaluate their practices in the best possible way. In this sense, understood as a general frame of reference throughout the process, among those principles that can be useful in promoting quality in the conduct of different research phases and, therefore, of the evidence that allows us to assist the educational intervention, we can highlight the following:

- **Principle of opportunity** In a synthetic way, we can understand this general principle as the need to take a good definition and justification of a research question as a starting point that will guide the whole process and serve to meet a need. In this sense, a problem must be formulated that is relevant to educational practice, generally derived from direct experience with the phenomena of interest, which should allow for an initial assessment of the current situation and, subsequently, the rationale for a given intervention in relation to the knowledge established in a theory previously developed within the framework of scientific research.

- **Principle of coherence** Once the research question is articulated, the second principle refers to choosing the most suitable methodology to answer it. As a consequence of this reasoned choice, the chosen research method will serve as a frame of reference to guide all the decisions involved in determining the type of information needed (quantitative, qualitative or a combination of the two), the selection of the most appropriate techniques to systematically collect it, the identification and selection of the participants necessary to do it and, finally, the organisation of all the logistics involved in developing the necessary fieldwork.

- **Principle of rigour** As a result of the method adopted in the research, this general principle relates to the scrupulous fulfilment of the plan that has been previously drawn up with the objective of systematically collecting and analysing the information obtained during the fieldwork. Once the data are organised, their quantitative or qualitative nature will be decisive in choosing the most convenient analysis techniques that, once applied, will facilitate the precise processing of the data to obtain the results. These

results, as we have said, constitute the evidence that will support the conclusions to which the investigation ultimately leads.

- **Principle of transparency** To close the cyclical or iterative process that characterises scientific research, the last general principle includes the unavoidable undertaking of rendering accounts in relation to each and every one of the decisions that lead to answering the initial question. In this sense, it is not only necessary to adequately present the conclusions from which the newly obtained knowledge is established, but, what is even more important, the evidence that can justify it and a clear and detailed description of all the procedures carried out to obtain it, so that the research process can undergo independent external scrutiny.

As a consequence of this pragmatic approach, the fulfilment of the basic principles that are derived from it is an essential condition for obtaining quality evidence, but the truth is that not all scientific evidence has the same value. If, as we said, the markedly empirical nature of the scientific research process makes it impossible to give a value of absolute certainty to the knowledge it provides, it is also important to remember that its relative certainty always plays a direct role in the strength or sufficiency of the proof or evidence that can be offered as a guarantee.

In this sense, the principles of opportunity, coherence, rigour and transparency that serve to guide the practices and procedures involved in research cannot lead us to overlook the fact that not all methods are equally appropriate for answering a certain question. As we have discussed before, aiming to determine what works, by comparing the results of different types of educational interventions, is not the same as trying to delve deeper into the reasons why it does so. In fact, the former would be a good example of a question where, whenever feasible, experimentation would be the method of choice, due to the control it can exert on the effect of any other factor external to the intervention. The latter, on the other hand, would be a good example of a question where non-experimental or observational research in natural contexts could could provide details about the particular circumstances that explain the success or failure of the intervention.

To properly understand the difference between these two settings and the consequences in relation to the evidence they provide, it is necessary to briefly dwell on an important concept such as the validity of the investigations. Taking into account its etymological origin, the term *validity* is a derivative of the Latin adjective *validus*, which serves to reflect the property of strength, power or capacity of the things, people or ideas it describes. In this sense, with respect to the scientific research process that concerns us in this text, the validity would refer to the degree to which the evidence we can obtain, and on which it is based, reliably corresponds to what actually happens with the phenomena we want to learn about. Although it is possible to identify different types of validity, we will focus on the two most important types in this brief introduction. On the one hand, internal validity concerns the guarantees that certain research is able to provide in relation to the degree to which the observed relationships are, in fact, sufficient evidence for deducing the existence of causal relationships. On the other hand, external validity deals with the guarantees that we have that the results of the research are, in fact, sufficient evidence in relation to the degree to which it is possible to generalise the relationships observed in other people, different contexts or moments.

A matter of confidence in relation to the evidence

Although it is possible to find different approaches towards the concept of validity, even applied to the measurement by tests in the field of psychometrics, the basic distinction between internal and external validity was the original proposal of Campbell and Stanley (1966), later expanded upon by Cook and Campbell (1979), to identify the different threats that can put at risk, or, in fact, invalidate, the conclusions obtained in a particular investigation. See also Shadish, Cook and Campbell (2002) for an updated version of this discussion.

As you can no doubt see, these two types of validity have much to do with the two settings that we have just characterised, and it is precisely in the opposition between experimental and non-experimental research that we can understand their relationship from a concrete example. Imagine, for example, that the problem that concerns us was the incorporation of ICT in schools as an instrument in helping to improve student learning. In this sense, the systematic review and evaluation of the quality of the previous investigations would serve to determine that, indeed, there are a multitude of investigations that have proven that their introduction in the classroom leads to an improvement in the performance of the students. In fact, we even have a plethora of evidence that, in experimental settings, has demonstrated this effect over recent decades. Let us suppose, then, that we carry out an educational intervention based on this evidence and that we decide that, as has happened in educational administrations in other countries, it is appropriate to acquire the necessary equipment to make this improvement in our classrooms. Once the investment has been made, devices have been acquired and made available for teaching and learning purposes; however, suppose that the results of the evaluation of this fictitious intervention were not as expected and there is a need to understand why this happened. How is it that, although the evidence has supported the existence of a causal relationship between the incorporation of technology and the improvement of student performance, this effect has not materialised?

Turning to the promise of introducing technology in schools

The student interested in the discussion behind the example can consult the works of Clark (2012) who, during the eighties and nineties, showed that the conditions under which computers were used were responsible for the educational benefits they provided, and not the computers themselves. In this sense, his review of the evidence revealed that the comparison groups used in the experimental investigations had not always been exactly equivalent and, therefore, not only differed in the availability of technology, but what is even more important, in the teaching and learning practices developed in the classrooms.

Consistent with a plethora of observational investigations also conducted during recent decades, what we would probably find is that it is not technology, but everything that surrounds its incorporation into the classroom, that explains its educational benefits. Having the appropriate knowledge to use it, the necessary technical and pedagogical support, as well as an adequate de-

sign of the learning activities, would be some of the factors responsible for the improvement in student outcomes. But this conclusion would not be the result of the experimental research that initially would have allowed us to justify our fictitious intervention upon. On the contrary, only by comparing the contexts in which the intervention has worked with those in which it has not, by developing new non-experimental research, could we come to understand in what circumstances it is possible, in fact, to verify the expected effects and, in this way, generalise the causal relationships that had originally been demonstrated in experimental settings. In this sense, what allows us to illustrate this example is nothing other than the need to raise the different research questions with which it is possible to address the same problem; the value of the results that different research methods can bring in line with these questions; and how, in the end, what allows us to advance our knowledge about phenomena is the accumulation of evidence obtained in several independent investigations developed in many different contexts.

Paraphrasing the poem by John Donne, no research is an island in itself and, although the advancement of our knowledge about phenomena depends to a large extent on the quality and the strength or sufficiency of the evidence obtained, the truth is that the degree of certainty that the scientific research process can provide us with is closely linked to our ability to adequately connect the results that, as partial answers to different questions, are offered by each and every one of the investigations carried out in the same field. By closing the circle of this complex process, it is only in this way that it will be possible to jointly build a better understanding of the phenomena based on the available scientific evidence which, in the case of the educational intervention that occupies us in this text, allows the different professionals involved to found and evaluate their own practices so as to develop them in the best way possible and, ultimately, contribute to the common good.

4. Annotated bibliography

Finally, before moving on to the other modules in this manual, it is important to keep in mind that for reasons of space it is not possible to deal in depth with each and every one of the aspects related to the design, management and communication of the results of research or, at least, do so with the degree of detail that other more specialised works can devote. On the contrary, what we have aimed for in this text is to provide a general overview, illustrated with some practical cases. Therefore, it is advisable that interested students complement our approach with other contributions that can help broaden the development of their professional competence in research.

In this sense, beyond the references that we provide throughout the different modules, we also have some manuals on research methods and techniques published in our context that would be interesting to consider such as, for example, those of Leon and Montero (2015), García, Alvira, Alonso and Escobar (2015) and Fàbregues, Meneses, Rodríguez-Gómez and Paré (2016).

Likewise, to close this module, below we offer a selection of some relevant contributions made in the international context that may be useful for acquiring a broader vision about educational research, the design of research projects and the preparation of results reports.

- Cohen, L., Manion, L., and Morrison, K. (2011). *Research methods in education* (7th Ed.). Abingdon: Routledge.

As a general introduction to the subject, this book is an excellent approach for those who have no previous experience in educational research. Organised into five parts, it reviews the context in which the research is produced, its organisation and planning, the different perspectives from which it is possible to carry it out, the strategies and instruments available to obtain the information and, finally, the different approaches to analysing the data obtained. Using accessible wording, the authors aim to offer a comprehensive view of all the details involved in the design and conduct of educational research, presenting the major debates that are still current, as well as their practical implications and, in addition, the text is accompanied by many examples and illustrations that facilitate their reading.

- Fraenkel, J., Wallen, N. E., and Hyun, H. (2015). *How to design and evaluate educational research* (9th Ed.). Boston: McGraw-Hill.

As a complement to the previous reference, this text also serves as a general introduction to many of the important issues that must be taken into account in order to design and evaluate educational research. Starting from a gener-

al presentation in which the authors explain the specificities of this field of knowledge, they organise their explanations around some key concepts that then give way to a discussion about the different research methods and techniques available to be able to develop it and the analytical strategies that derive from them. Finally, they close with a final chapter dedicated specifically to the writing of projects and the reporting of results. With a simple and enjoyable style, this text also provides a multitude of practical examples that can guide the student when it comes to carrying out their project.

- Wyse, D., Selwyn, N., Smith, E., and Suter, L. E. (2017). *The BERA/SAGE Handbook of educational research*. Los Angeles: Sage.

The editors of this book, which is structured in two volumes, offer a considerable compilation of contributions developed by different authors as a comprehensive compendium organised into six parts. A general introduction serves to position the most significant debates on educational research and then the following fifty chapters cover some key questions for understanding educational research; its planning; the different approaches available to develop it; the process of obtaining data; the strategies with which it is possible to analyse said data; and, finally, a discussion about the communication and the evaluation of results. Promoted by the British Education Research Association, this text, which has recently been published, is a good reference to enable students to delve into the specific aspects that go beyond the more general approaches.

- Bell, J. and Waters, S. (2014). *Doing your research project: A guide for first-time researchers* (6th Ed.). Berkshire: McGraw-Hill Education.

After three decades and five revisions since its first edition, this manual articulates its explanations around the research project. For this, the authors follow a three-part structure that allows them to present the three most important points of research in the field of social sciences. Firstly, the basis of the research, which begins with the conceptualisation of the problem, the planning of the project tthat will address the problem, and the search, review and management of the literature that will serve as a context to guide it. Then, the selection of the most appropriate method for conducting the research project and, therefore, for obtaining the necessary data. Finally, the last section deals with the analysis of the data, placing emphasis on the interpretation of the results and the drafting of the final report.

- Denscombe, M. (2017). *The good research guide for small-scale social research projects* (5th Ed.). London: Open University Press.

With a practical orientation, this manual aims to provide guidance for people who, far from the conditions that may be subject to in the academic context in terms of time dedication, the organisation of teams and the availability of resources, are considering conducting a small-scale project during their training or as part of their professional activities. By assuming a leading role in the

whole process, the text structures the most important decisions in relation to choosing the method, the procedures derived to collect and analyse the data and, finally, ends with a discussion concerning the ethical implications and offers some recommendations for the preparation of reports and the and carrying out literature reviews of literature reviews. With a clear and direct style, the practical examples and checklists that accompany each chapter are very useful resources that facilitate the interpretation.

- O'Leary, Z. (2017). *The essential guide to doing your research project* (3rd Ed.). London: Sage.

Finally, to close the selection of references that are structured around the decisions that need to be taken to develop research projects in social sciences, this manual offers a very comprehensive, panoramic view that allows the student to position themselves in relation to the different steps that must be followed and, particularly, the multiple difficulties that they will have to face when making their decisions. Starting from an initial chapter that serves to present the basic aspects of the research process, the text follows a familiar logic in which it addresses all the initial preparations, the development of the research question, the review of the available literature, the choice of method that will articulate the whole process and the techniques for obtaining and analysing the data and, finally, the challenge involved in communicating the results.

- Booth, W., Colomb, G., Williams, J., Bizup, J., and FitzGerald, W. T. (2016). *The craft of research* (4th Ed.). London: The University of Chicago Press.

This is a classic reference on the communication of research results. Recently revised, this book invites researchers of all profiles to think about the audience who will receive their messages and, thus, places its focus on the skills and resources needed to find and evaluate the most appropriate sources, organise and properly construct the arguments and, therefore, anticipate the expectations and respond to the criticisms that the readers may make, as receivers, once they have the results of the investigations in their hands. In this sense, it is an exceptional complement to the conventional research method manuals, since it is full of practical recommendations and good advice that facilitate the effective dissemination of the results after so much effort.

- Montgomery, S. L. (2017). *The Chicago guide to Communicating science* (2nd Ed.). Chicago: The University of Chicago Press.

In the range of manuals aimed at the preparation of results reports, this text is aimed at students, professionals and academics interested in making effective oral or written presentations on their research conclusions. In this sense, the recommendations offered can be useful not only in the academic context, but also in professional practice in public administrations, companies or the third sector, identifying the practices that can effectively contribute by adopting the scientific language as a form of communication, adapting this language to the

different formats and contexts in which the dissemination of the results takes place before the different audiences and addressing some important issues in this area, such as plagiarism, fraud, the translation of scientific texts and the relationship with the public using the media.

- Yates, L. (2004). *What does good education research look like? Situating a field and its practices*. Maidenhead: Open University Press.

Finally, although it is not recent, this manual is very interesting because it allows us to understand in a simple way what the different products that can be developed from the research carried out in the field of education are, what characteristics they have and at whom they are aimed. Adopting a critical perspective, the author addresses the specificities of doctoral theses, funding requests, scientific articles, research reports, books and the relationship with the press, offering practical recommendations to be able to respond successfully to explicit and implicit quality criteria in each context, showing the most common errors and, therefore, meeting his goal of demonstrating what good research is, or what it should be, which can serve as an inspiration for us to carry out our own.

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