Cómo se predijo el tiempo de confinamiento por la covid-19: implicaciones de la "inteligencia colectiva" en la investigación educativa

How covid-19 lockdown time was predicted: implications of "collective intelligence" in educational research

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RESUMEN.
La Covid19 ha supuesto una de las mayores amenazas mundiales desde la segunda guerra mundial. Los modelos formales para estimar su evolución han sido múltiples, pero no se ha encontrado ninguno que estimase el tiempo de confinamiento, lo que podría aportar un dato para gestionar la ansiedad de la ciudadanía ante la incertidumbre. Este estudio se planteó hacer una estimación de los días de confinamiento en España, utilizando la Inteligencia Colectiva. Otros dos objetivos fueron analizar la precisión de la estimación y debatir el potencial del procedimiento para la investigación en Educación. Se contó con una participación de 203 sujetos. Se realizó un análisis descriptivo, estimación de parámetros y un grupo de discusión. Los resultados muestran una estimación relativamente precisa, con diferencia por edad y género. Finalmente se debate sobre la capacidad de usar la inteligencia colectiva como recursos docentes, así como para la investigación e innovación educativa. Se comentan sus limitaciones y la necesidad de estudiarse con más profundidad por parte de la Pedagogía.

PALABRAS CLAVE.
Coronavirus, Inteligencia colectiva, España, Confinamiento, Investigación en Educación.

ABSTRACT.
Covid19 has been one of the greatest global threats since the Second World War. The formal models to estimate its evolution have been multiple, although none was found estimating lockdown time, which could provide data to manage citizens' anxiety in the face of uncertainty. This study set out to estimate the days of lockdown in Spain, using Collective Intelligence. Two other objectives were to analyze the estimation accuracy and to debate the potential of the procedure for research in Education. There was a participation of 203 subjects. A descriptive analysis, estimation of parameters and a focus group were conducted. The results show a relatively accurate estimation, with a difference between age and gender. Finally there

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is a debate regarding the ability to use collective intelligence as a teaching resource as well as for educational research and innovation. Its limitations and the need for further study by Pedagogy are discussed.

KEYWORDS.
Coronavirus, Collective intelligence, Spain, Lockdown, Research in Education.

1. Introduction.

The international emergency of the new SARS-CoV-2 coronavirus that has caused the COVID-19 pandemic is perhaps one of the most important global threats since the Second World War. Although, this pathogen could have been present for a long time in the Chinese region (Spaniards became ill in the Wuhan military games and upon their return presented symptoms compatible with Covid-19, 2020), it was in December 2019 when COVID-19 was identified as the disease (Anonymous n.a.).

On March 16, 2020, the Spanish government imposes a nationwide lockdown without a specific end date (BOE.es - Document BOE-A-2020-3692, of March 14, 2020).

In addition to the uncertainty surrounding the pandemic, there are also the possible effects of the lockdown. Generally, situations of uncertainty directly affect individuals' psychological health, increasing their stress load (Hinojosa-García and Alonso-Castillo, 2019; Brooks et al. 2020).

In this context, various initiatives emerged to model the evolution of the pandemic using formal projections, based on time series, regression, Bayesian estimation, etc. (e.g. Durán 2020; Flaxman et al. 2020). However, these models showed very low concordance for different reasons (Anonymous n.a.; Sampedro, 2020; Sevillano, 2020). Conversely, although the authors of this article conducted an active online search, no initiative was found that tried to estimate how long the lockdown would last.

Although having a projection on the evolution of the pandemic was and is very important, it was also important to have an estimate of how long the lockdown could be prolonged. As indicated above, it could be a factor that allows citizens to more effectively manage their uncertainty and thereby lower their anxiety levels. It is within this context, where the initiative arises to look for a procedure that estimates this data from the Social Sciences.

In the field of Social Sciences, the phenomenon of "group wisdom" or "collective intelligence" is well known. For more than a century (Mackay, 1841; Galton, 1907), it has been proven that the average assessment by a group in relation to a number of elements or a reality can be more accurate than estimates by experts. This phenomenon has been studied throughout the 20th century, confirming that the average execution of a group in decision-making is higher than the execution of the subjects individually (Seely, 1995; Malone et al, 2009).

This effect consists in the individual's ability to handle information of a very different type and source, including emotional aspects, to carry out a prediction or estimate. When a group of subjects is asked to carry out an assessment, they will do so based on all the information available to them, including facts, experiences, as well as their own intuition. The relationship between the individual assessment and the correct answer can be expressed as a statistical model (Engert, 2020) as presented in expression 1.

Person's appreciation = real value + individual bias + error (Expression 1)

When the assessment comes from a group of people, the components of expression 1 become variables that will have a certain statistical distribution. Assuming that each person has the same probability of guessing the real value, all predictions are independent from each other and that the probability is greater than 0.5, the Condorcet Jury Theorem shows that the probability of a correct assessment by a group increases with its size (Mossel et al., 2010). One interpretation of this phenomenon is that large enough groups of non-experts on a subject can arrive at a correct assessment. This approach can explain the phenomenon of collective intelligence. However, this explanation has its limitations (Enger, 2020) although analyzing them exceeds the objective of this article.

Finally, the aim of this research was to estimate how long the lockdown would last in Spain, as well as the number of possible infections and deaths.

A second objective was to analyze the accuracy of the estimation. As a third objective, an assessment of this procedure was established as a resource for Education and research in Education.

2. Method.

A survey design was conducted which included a final incidental sample of 203 participants. The average age of the participants was 40.5 (s.d. = 13.7). 57.1% were men, with an average age of 44 (s.d. = 13.6). 42.9% were women, with an average age of 35.8 (s.d. = 12.4). The age distribution of the participants does not follow a normal distribution.

A questionnaire implemented in Google Form (1) was used to collect the data. The questionnaire includes the following questions: age, sex, Indicate how many days you think the lockdown will last (days in total since it began on March 16), Indicate how many people you think will be infected in Spain during this crisis, and indicate when you think this crisis will end in Spain. All questions were formatted as numbers, except the last one, which was a dropdown menu which showed the months. The question about the number of deaths was included four hours after publishing the form. For this reason, the number of responses is significantly less.

The questionnaire was available from March 22, one week after lockdown started in Spain, till April 2, 2020. The number of responses gradually declined, from 123 questionnaires on the first day, 33 on the second, and so on until April 2 when only 8 were collected.

The data was reviewed to identify possible abnormal cases. Only one empty record and two 0's were deleted. A daily estimation of parameters was made from the records and their accumulated data. In the question about when the crisis would end, no estimation of parameters was made; instead the highest ranked options were taken. The data is available under the Common Creative drawing license, the link of which can be seen in note 2.

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First, drawing from the records, a global descriptive analysis and estimation of the population average were conducted. For this, a 95% confidence level was established.
In order to analyze possible differences in the participants' response, a grouping was made by age intervals, applying the corresponding hypothesis tests to analyze possible differences by population segments and within them, between men and women. Given the nature of the data, the Kruskal-Wallis test was applied at a significance level of 0.01. For all analysis, R 3.5.0 (R Core Team, 2018) and its jmv library (Selker, Love & Dropmann, 2020) were used.
Finally, a brief report of the results and the procedure followed was done and uploaded to the SocArxiv repository the link of which is available in note 3. This report was sent to four teachers/ researchers from different fields to assess the possibilities of the procedure. The group was made up of a 62-year-old educational counselor from the Andalusian Government, a Pedagogue professor from the University of Granada, a Pedagogue professor from the University of Seville and a Pedagogue and Teaching professor from the University of Malaga. Using an online focus group format, a record of the contributions and a summary of the conclusions of the debate were conducted.

3. Results.

Initially, a descriptive analysis of the records was conducted, for each variable, day by day. Table 1 presents the results of the data from March 22 to 25. The last column holds all the records until April 2.
It is apparent that the days of lockdown estimate is quite stable from the beginning, concluding with an estimate of 51 days, within a range that could go from 49 to 54. The distribution has a slight positive bias, which can be verified by contrasting the median with the mean. This would indicate that the responses are very extreme. In fact, the maximum recorded in this variable was 180 days with two records, followed by 100 days with a single record.
Regarding the number of infections, the final result gives an estimate of almost one million people. In this case, the estimates in the first records are more catastrophic than at the end, which is noteworthy. However, the confidence interval is very wide, which undermines the accuracy of the estimation.
Regarding the number of deaths, the first records are also more pessimistic. A very marked positive bias is also observed, of up to 2.31 points with the total number of records, which indicates very extreme values in the estimate. All this grants a lethality of 2%.
Finally, there was a debate between May and June in regards to when the lockdown would end, with May coming out on top in almost all cases.

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Table 1. Descriptive statistics by periods of days.

	22/03/2020	23/03/2020	24/03/2020	25/03/2020	2/04/2020
Lockdown days from March 16.	Average: 47,2 (44~50) Median: 45 n=123	Average: 49,2 (48~52) Median: 45 n=156	Average: 50,5 (48~53) Median: 45 n=173	Average: 50,3 (48~53) Median: 45 n=195	Average: 51,2 (49~54) Median: 45 n=203
Infected:	Average: 1.130.000 personas (348793~1901725) Median: 60.000 people n=120	Average: 1.187.987 (751907~1994323) Median: 60.000 n=150	Average: 1.103.079 (706084~1837144) Median: 70.000 n=165	Average: 988.234 (639065~1633867) Median: 80.000 n=188	Average: 954.745 (619636~1574382) Median: 80.000 n=196
Deaths:	Average: 26.933 (2115~51751) Median: 5.000 n=88	Average: 22.242 (12288~40648) Median: 5.000 n=119	Average: 21.020 (12237~37260) Median: 5.000 n=135	Average: 19.482 (11925~33455) Median: 6.000 n=157	Average: 19.178 (11987~33475) Median: 6.000 n=165
End of the crisis:	May (30.3%) June (24.6%) =123	May (25%) June (25%) n=156	May (25%) June (23.8%) n=173	May (26.8%) June (23.2%) n=195	May (26.2%) June (22.3%) n=203

Once a global analysis of the data was conducted, which met the first aim of the study, a more detailed study of the first three variables was done, dividing the participants by age segments and, within them, by gender. Since the assumptions of normality in the base distributions were not met, the Kruskal-Wallis non-parametric test was applied.

Table 2 shows the results for which this test presented significant differences. Firstly, it is worth noting statistically significant differences between all the age segments for the three variables in question, although the effect sizes are practically irrelevant. Thus, the lockdown time variable obtained a Chi-square of 13.3 ($p = .01$; $\varepsilon^2 = 0.06$), the number of infections presented a Chi-square of 19.4 ($p < .001$; $\varepsilon^2 = 0.09$) being the Chi-square of 26.5 ($p < .001$; $\varepsilon^2 = 0.16$) for the number of deaths.

Regarding the days of lockdown, the group of 50 to 59 year-olds is the most pessimistic (60.5 days) followed by those over 60 (56.4 days). On the other hand, the most optimistic is the group of under 30 (44.4 days), along with the group of 30 to 39 year-olds (49.6 days) and in an intermediate position the group of 40 to 49 year-olds (51.5 days). This shows that greater age would be associated with an estimate of more days.

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The previous trend is not repeated in the other two variables; in fact, those who estimate the highest number of infections and deaths are the group of under 30 (1650000 infections) and the group of 40 to 49 (1600000 infections). The group of 30 to 39-year-olds is the one with the lowest estimate of infections, with 136886. Something similar occurs with the estimation of deaths, where the segment of under 30 and the segment of 40 to 49 estimate around thirty thousand deaths. It is the 30 to 39 group where the estimate is lower, of 5157 cases.

Table 2. Averages by age and gender

Age	Gender	Days of lockdown	Infections	Deaths
Under 30	*Total*	*44.4*	*1650000*	*29596*
	Man	-	2170000	54077
	Woman	-	906753	5115
30 – 39	*Total*	*49.6*	*136886*	*5157*
	Man	-	222667	6875
	Woman	-	72550	3848
40 – 49	*Total*	*51.5*	*1600000*	*34268*
	Man	-	1200000	47906
	Woman	-	2570000	7844
50 – 59	*Total*	*60.5*	*164394*	*9703*
	Man	-	198571	11800
	Woman	-	104583	6315
60 or older	*Total*	*56.4*	*236455*	*13346*
	Man	-	270909	12545
	Woman	-	202000	14146

Note: (-) indicates that there were no statistically significant differences between gender at a confidence level of 99%.

Taking into account gender and age, differences only appear in the estimation of infections (Chi-square = 13,616; p <.001; $\varepsilon^2 = 0.06$) and deaths (Chi-square = 15,916; p <.001; $\varepsilon^2 = 0.09$) but again with minimal effect sizes. In any case, the results show that, as a general rule, men are more pessimistic in their estimates than women, although this is not true in all segments of the population (eg segment 40 to 49 for the number of infections). In Figure 1, lockdown days are represented by age to illustrate the differences, including the standard deviation, which shows the level of homogeneity for each age group.

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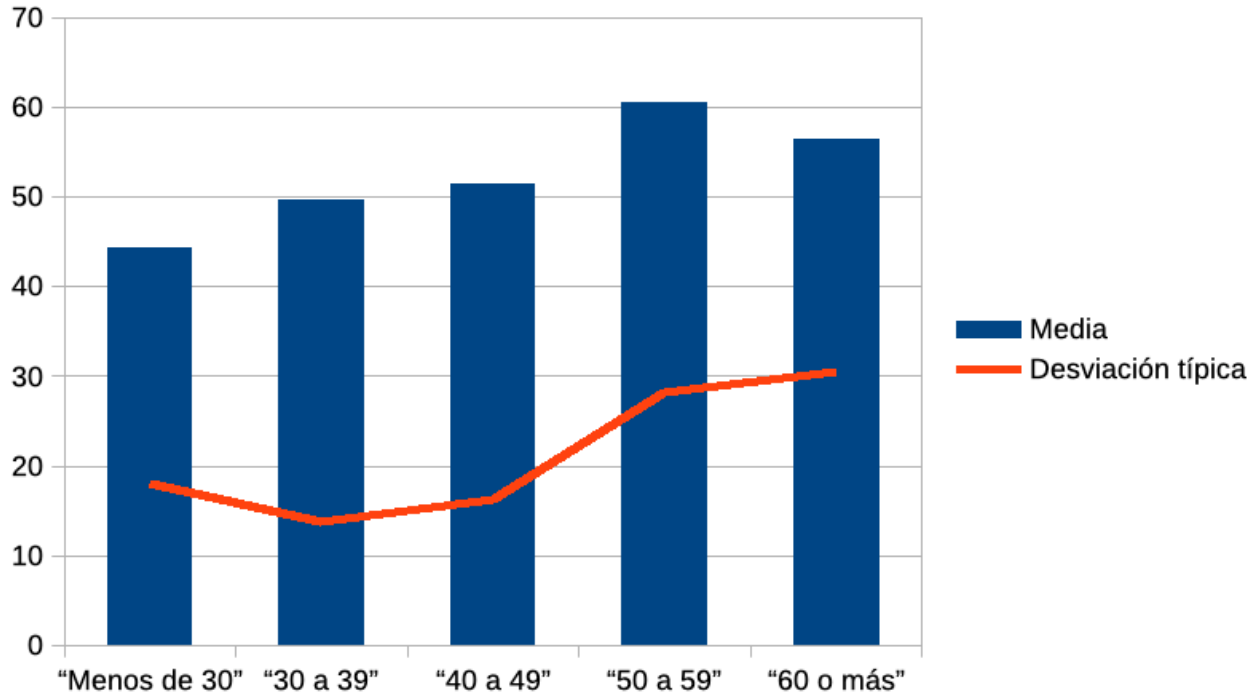

Illustration 1. Average and standard deviation of lockdown days by age group.

Regarding the estimation accuracy, the lockdown duration estimate marks May 6 as the end (March 16 plus 51.2 days), with an interval between May 4 and 8. The end of lockdown oficially occurred on May 9. Therefore, the absolute error was three days.

Regarding the number of infections, it is not possible to make a comparison due to the lack of precise official statistics. Regarding death tolls, as of May 9 it was 26478 according to official statistics (see note 4). Compared to the final estimate, which was 19178, the error is 7,300 cases. However, it is striking that the estimate from the first day of the survey was 26,933, which would mean an absolute error of only 455 cases. Finally, in relation to the month, a total success of lockdown completion is observed.

Finally, a group of four research professors evaluated both the results and the procedure used. They were asked to critically analyze its potential as an educational resource and as a resource for research in Education. To this purpose, a virtual meeting was held, where the contributions of the participants were noted.

Regarding its possible use as an educational resource, it was pointed out that dealing with a current topic such as covid19, was a way to hold students' attention, focus their interest, and take into account family implications (see quote 1).

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> Member 1. "[using estimates on a current topic] can be applied to Secondary and High School students, as a teaching strategy in the areas of Social and Natural Sciences. Teachers could meet objectives in their area (procedural) with students who would learn to research for themselves and with their family circles, on current issues. Quote 1.

However, the debate focused more on the capacity as a resource for educational research. Within this sphere, two main themes emerged, on the one hand, objectivity, and on the other, the democratization of research. Thus, for example, in relation to democratization, it was commented that, by using topics of interest and current affairs, by involving non-experts, and by linking with social aspects, the research process becomes accessible to all. Likewise, it was pointed out that in the training of researchers, it is a way of connecting reality and the University (appointment 2).

> Member 2: "[asking laypeople allows]" the interpretation and projection of educational proposals that allow an operational transfer in the educational context ". Quote 2.

In relation to objectivity, the debate was more intense. It was pointed out that the procedure allows balancing very extreme estimates or opinions, favoring a more objective treatment of the issues (appointment 3).

> Member 1. "It would allow us to speak about issues with greater objectivity but which, when shared, acquires a neutralization (of propaganda and critical control of information) with less dramatic overtones." Quote 3.

However, it was also noted that the procedure is no guarentee of objectivity, understood as reflecting the essence of a reality, and therefore, the results could be considered as a mere "curiosity", as expressed by member four in quote 4.

> Member 4. "[the result] is still a curiosity. Just because you think that a thing ends at one moment and with a certain result, does not mean that is the reality ". Quote 4.

4. Discussion and conclusions.

The discussion and conclusions are organized according to the three proposed aims, on one end the estimation of the days of lockdown, infections and deaths, on the other the precision of the aforementioned, and finally, the assessment of the procedure potential as a resource in and for Education.

Regarding the estimates drawn from the records, the low margin of error achieved in a context of high uncertainty in relation to the days of lockdown is remarkable. This is, without a doubt, the most accurate result considering all the records. On the contrary, the number of infected is estimated to be over a million cases. Which does not coincide with official statistics.

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However, it is expected that the actual number of cases will prove to be much higher than the number of registered cases, as indicated by some studies (Flaxman et al. 2020) as well as numerous newspaper articles (e.g. Sampedro, 2020).

According to the group's estimation on deaths, they would be around twenty thousand. Official figures estimate that, on the date of lockdown completion, the number of cases was much higher, although within the estimation intervals. However, in relation to this data, it is striking that the first estimate came very close to official data. This suggests that in collective intelligence there is a kind of interaction between factors, among which the group experience, the effect of authority, or the presence of some biases that affect group dynamics could be involved (see Yu, Chai & Liu, 2018).

Analyzing the population segments in more detail, it is observed that the older participants are more pessimistic regarding the days of lockdown. However, this pessimism only occurs in this variable. In fact, those under 30 years of age estimate the highest number of cases and deaths. Consequently, it is clear that a pessimistic estimate cannot be said to be directly linked to age. These results are consistent with studies on optimism, in which a boost in optimism is observed with age, until it plateaus at around 55 years of age (Schwaba, Robins, Sanghavi, & Bleidorn, 2019).

However, it is clear that there are differences by gender. Across all segments of the population, women tend to be more optimistic in their estimates than men. This result could contradict the idea that men tend to be more optimistic than women and therefore tend to take more risks (Jacobsen, Lee, Marquering & Zhang 2014). However, this interpretation would be debatable. Possibly, the tendency to estimate a higher number of cases and deaths is not only linked to the level of optimism-pessimism, but is due to other factors also linked to gender, such as the "third person effect" or tendency to value that a reality will affect others (hence the third person) more than oneself, this effect being observed especially in the field of communication (White & Andsager, 2017). In any case, it is a matter up for debate.

Regarding the estimation of the lockdown time, infections, deaths and end date, corresponding to the first aim of this study, it should be clear that the procedure is based on a psychosocial phenomenon, and as such, it cannot be taken as an accurate method, nor as an objective prediction. Although the results show quite a remarkable approximation to what has happened in reality, it cannot be mistakenly considered that the estimation procedure based on collective intelligence is better than estimates based on mathematical models, although its use will always depend on the context in which it is applied (Prelec, 2017).

Nonetheless, the small margin of error in the prediction of lockdown days is remarkable, as well as the accuracy of the death tolls in the first-day records. In this sense, it would be interesting to analyze the possible reasons that determined the correction of this data towards lower values in the following records. It is possible that, as previously pointed out, the knowledge generated by the group benefits or harms all the factors and variables of the context that affect it, so that the synergy generated in this dialectic is never the simple result of the sum of the contributions of its members.

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Before continuing with the discussion, it is necessary to note some of the limitations the study presents in relation to the prediction made, so as not to fall into the error of extolling a result that may be casuistic. In this sense, it is necessary to comment on some issues:

- The estimate is based on the opinion of the group of participants, so it cannot be taken as an estimate whose validity is guaranteed. Therefore, precaution is adviced in order to avoid taking the results as an absolute truth.
- The process followed is based on the survey method, however, the recruitment of subjects is more similar to the non-probability "snowball" sampling, preventing them from assuming their representativeness in relation to the Spanish general population. Again, common sense in needed when interpreting the results.
- The instrument used is very limited. The questionnaire did not include questions that are usually included when conducting studies of a different nature for the reasons given above. In this sense, it has not been possible to conduct more powerful analyses to inquire about possible links between the person's variables and the estimate.

Once the limitations on the estimation of the Covid have been discussed, we move on to the last aspect dealt with in this research, perhaps the most interesting, yet less notable. This is the analysis of the potential of collective intelligence for Education, both as a resource in the classroom and as a resource for research. From the focus group, it has been concluded that this phenomenon of collective intelligence has great potential in both fields.

The debate in the discussion group has reached conclusions that, in future research, should be tested. On the one hand, it is indicated that this procedure can be used in the classroom as an educational resource. For this, teachers would propose a current topic, and students, would debate about it from a novice's stance. Subsequently, it would be possible to conduct another type of complementary strategy, such as the proposal of a research project, to investigate the topic and assess the plausibility of the previous debate. This procedure, for example, would allow the identification of extreme initial positions, without the group's opinion being considered erroneous. On the other hand, it could also be used as training for researchers who are doing their Master's or PhD.

This way of using collective intelligence is similar to supervised computer learning. Students develop a learning activity (algorithm) and the result is compared with a criterion that acts as a supervisor or criterion to identify the possible system error.

Moreover, the focus group has indicated that, by using topics of interest, and by resorting to non-experts, two things can be achieved: one is the democratization of educational research; the other is connecting the University with the outside world. In some way, didactic strategies such as those mentioned could be used to reduce the University-Citizenship gap.

The group of experts has not neglected the internal validity of the procedure. Undoubtedly, the issue of objectivity is linked to the confidence that can be had in the estimates and in the data collected by this means. As noted before, the process is based on a psychosocial phenomenon and although there are numerous cases described in the literature that show the efficiancy of the procedure (see Yu, Chai & Liu. 2018), it is worth questioning how many experiments did not come to fruition and therefore were not published (Fanelli, 2012). For this reason, collective intelligence is presented as a useful resource for both teaching and

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research. But its use and potential must be under the strict supervision of a specialist, as one would say in a package insert. For example, the following recommendations should be taken into account:

- Estimation experiments, as teaching resources, should be used as part of a set of activities that favor critical debate.
- The debate on current issues must have a broad representation of all opinions or positions. The estimated value arises from the average of all contributions, and not from the simple majority.
- In research, it will allow to obtain an indicative result that must subsequently be verified. It should not be taken as true until then.
- It is a procedure that favors debate and analysis from very different perspectives as long as it guarantees that the groups are non-experts in the field. This facilitates the search for innovative solutions to new challenges.
- Related to the above, this group dynamic may favor the identification of new topics that experts may not take into account. In this sense, it is a good resource to monitor laypeople's concerns and ways of facing reality.

Finally, although collective intelligence has been widely studied in Social Psychology, the same has not happened in Education Sciences. It is recommended that Pedagogy also be interested in it, as a resource for teaching, as a resource for research, for the potential it presents, and which this brief article has tried to highlight.

Notes.

(1) https://docs.google.com/forms/d/e/1FAIpQLSfOzOtlhpYBKlOWeQsQEG7pMoLwkxAJmaYfmlCO_PrPZTWNBg/viewform
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