RISK PERCEPTION CONCERNING COVID-19 PANDEMIC, GLOBAL WARMING AND FOOD AND NUTRITION SECURITY BY PRESERVICE SCIENCE TEACHERS

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Manufactured risks, generated by scientific and technological progress, are increasingly present in modern social life. Dealing with those risks require the ability to understand complex contexts and make decisions based on judgments. To understand risk perception among students a survey was developed and applied using the Amplified Risk Perception (ARP) theory based on three different manufactured risks: Global Warming, COVID-19 Pandemic and Food and Nutrition Security. The students were asked to answer the survey before and after the course and to develop a Teaching and Learning Sequence (TLS) about one of these three themes. Preliminary results shows that pre and post-tests had statistically significant differences between each other, resulting in an increased risk perception. Both the course and the TLS' development were significant to increase risk perception as well as the ARP's diagram, which made possible to create an assessment tool to evaluate teaching-learning situations.

Keywords: Socioscientific Issues; Diagnostic Tools; Scientific Literacy

INTRODUCTION

The pandemic caused by SArs-CoV-2 virus is spread all over the word. After more than two years, people are still fearing death and lacking the ability to deal with uncertainties that came in simple tasks of daily life. A diffuse feeling of insecurity pervades people's minds when they need to face risky situations, i.e., problems with no clear boundaries that are involved in unpredictable consequences. Otherwise, science was seen as a source of certainty that humankind has used to overcome fear and feeling of insecurity. Notwithstanding the benefits developed by science and technology all over the last 300-hundred-year, people feel more vulnerable and exposed to more risks (Douglas 1994).

Nowadays, risk situations are characteristic of today's industrial society and it emerges from complex situations, where many dimensions of social life like health, economy, science, and others are combined. (Beck et al. 2013). For Ulrich Beck (1992), we are living in a Risk Society, characterized as an age of Reflexive Modernity (Beck, Giddens and Lash 1994). In this kind of Modernity, central concerns of society have changed from developing and implementing recent technologies to managing risks associated with already existing technologies. In Risk Society, it is possible to distinguish between two types of risks: *external* – generated from outside of modern social life – and *manufactured* – generated by progress of humankind social and technological development. The external risks are more accessible and easier to be evaluated with basic knowledge and scientific support. But manufactured risks are normally hidden behind the complexity of Contemporary problems, as for example in the case of Covid-2019 pandemic. Search solutions in this scenario of Risk Society and complex problems require to be prepared to deal with dilemmas: health x economy, or safety and earning money. Kolstø

(2001), as expatiates on socioscientific dilemmas, shows that students question risk assessment sources and their trusty relation on scientist intentions. In the Risk Society, trust does not arise from precision and authority. Instead, it comes from the ability to perceive multidimensionality in different contexts and producing adjusts on the go (Christensen 2009). Christensen reinforces the relevance of themes related to risk situations in school training for citizenship as it can take off from science the full ability to explain, predict and control all kinds of problems.

With this investigation, we aim to understand how manufactured risk may be an educational issue for science education. Specifically, we would like to develop teaching and learning sequences (TLS) to prepare students to perceive manufactured risk associated with Contemporary problems. Also, we may want to develop a tool to evaluate risk perception to be used in science classes/courses.

RATIONALE

Christensen (2009) argues that students' analysis is weakly grounded in their science knowledge or their understanding about the problem in place when they make risk assessment. The perception about risk is important in its management. It presumes to be able to discriminate distinct aspects presented in the situations, to evaluate consequences using reliable sources, and make a decision based on judgment. Simplistic causal relations, readily taking few available elements in the account must be avoided (Hansen and Hammann 2017). Thus, we adopt the diagram of amplified risk perception (ARP) (Pietrocola at. al, 2020), shown in Figure 1, to follow the way people's perception about manufactured risk may evolve. The ARP is a three-dimensional risk perception space indicating a group's ability to perceive risks related to a particular situation. *Access* is associated with rational thinking supported by scientific cognition. *Urgency* defines a hierarchy of risk connected with values and practices in each culture. *Range* relates to the ability to make impact assessments either in a close or far perspective. This three-dimensional risk perception space indicates one's (or group's) ability to perceive risks related to a particular situation.

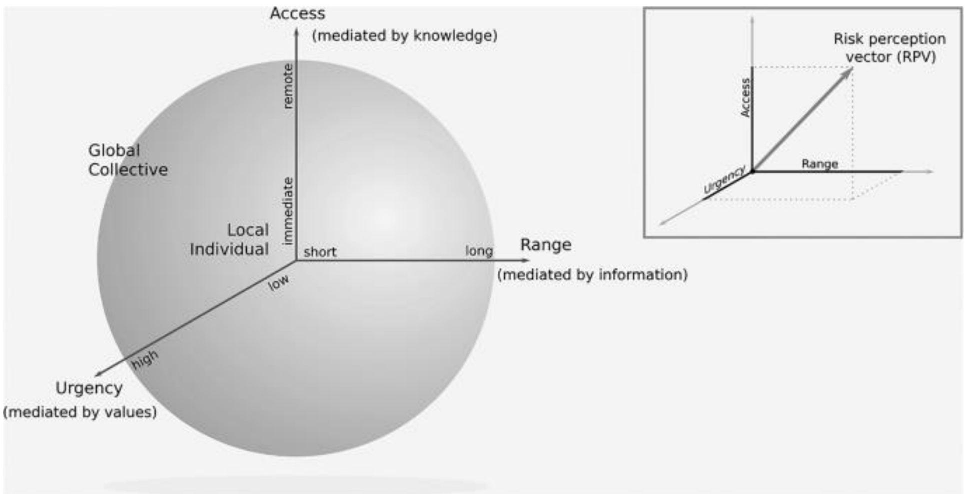

Figure 1. - The Amplified Risk Perception (ARP) diagram

In a course dedicated to prepare Pedagogical interventions in science classes, pre-service science teachers prepare Teaching and Learning Sequences (TLS) about the themes: (i) Global warming (GW), (ii) Covid-19 Pandemic 2019 (PCOV) and (iii) Food and Nutrition Security (FNS). They all three are defined as a manufactured risk (Giddens, 1990), and representing risk situations faced in the present moment (PCOV), immediate past (GW), and in immediate future (FNS). During the course, students were asked to read articles about risk perception and management, to choose a risk situation related to one of the three main themes and to make their own risk management's matrix, based on their appropriation of the subject. Later, each student chose one of the 3 themes to develop a TLS for science classes at High School level. In groups of 10 to 12 they were able to discuss which subjects were more significant to their TLS.

RESULTS

In this first analysis, we used the ARP diagram to identify and locate students within the Access, Range and Urgency axes through the risk perception survey. To calculate these indexes, we considered the simple average responses, according to the degree of agreement. Figure 2 shows the distribution in both pre and post-tests.

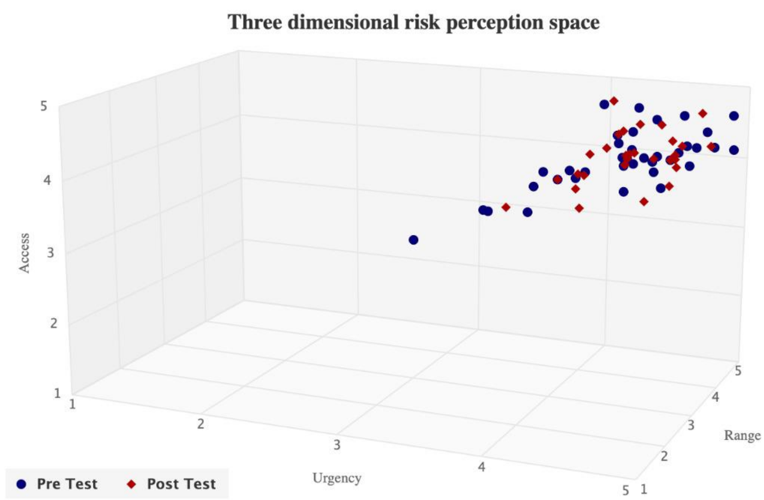

Figure 2. - Students' distributions according to the ARP diagram

Visually, we were able to notice a greater dispersion of students in the parts closer to the axes in the pre-test, compared to the post test result, indicating that there was an increase in the risk perception throughout the course. Additionally, we used the Wilcoxon signed-rank test to determine statistically whether there were significant changes in risk perception, comparing the results before and after the course, using the computer software Jamovi, assuming the hypothesis that the post-test means (M2) are greater than pre-test means (M1), which indicates an increase of risk perception. Table 1 illustrates this data.

Table 1 – Paired Wilcoxon result comparing risk perception before and after the course

	Pre-test	Post-test				
	Mean (M1)	**Mean (M2)**	**N**	**Statistics**	**p**	**Effect Size**
Urgency[1]	4.26	4.32	29	56.50	0.107	-0.3392
Range[2]	4.05	4.09	29	80.00	**0.040**	-0.4203
Access[3]	4.11	4.18	29	53.50	0.143	-0.3007

1 – 11 pairs of value are tied; 2 – 6 pairs of value are tied; 3 – 12 pairs of value are tied

Note: $H_a\mu_{M1-M2} < 0$; $H_0\mu_{M1-M2} = 0$

It was observed there was a meaningful change in all axes of the ARP diagram, with a greater variation in the Range axis. The Effect Size values indicates moderate (between 0.3 and 0.5) change directed to M2 which denotes greater risk perception, assuming there is a notable change between the pre and post-test means. The p-value for the Range axis represents statistical significance (< 0.05) against the null hypothesis and strong evidences that the students had their risk perception affected by the course. Although, the same result was not observed for the Access and Urgency axes.

Individually, each questionnaire had equivalent results, with meaningful p-value and Effect Size in one axis. Tables 2, 3 and 4 show Covid-19 Pandemics, Global Warming and Food and Nutrition Security results, respectively.

Table 2 – Paired Wilcoxon result comparing Covid-19 pandemic's risk perception before and after the course

	PCOV Pre-test	PCOV Post-test				
	Mean (M1)	**Mean (M2)**	**N**	**Statistics**	**p**	**Effect Size**
Urgency[1]	4.37	4.39	29	36.50	0.473	-0.0641
Range[2]	4.19	4.14	29	83.00	0.789	+0.2206
Access[3]	4.34	4.41	29	02.50	**0.052**	-0.7619

1 – 17 pairs of value are tied; 2 – 13 pairs of value are tied; 3 – 23 pairs of value are tied

Note: $H_a\mu_{M1-M2} < 0$; $H_0\mu_{M1-M2} = 0$

Table 3 – Paired Wilcoxon result comparing Global Warming's risk perception before and after the course

	GW Pre-test	GW Post-test				
	Mean (M1)	**Mean (M2)**	**N**	**Statistics**	**p**	**Effect Size**
Urgency[1]	4.25	4.35	29	09.50	0.066	-0.5778
Range[2]	3.79	3.92	29	00.00	**0.004**	-1.0000
Access[3]	3.87	3.90	29	49.00	0.275	-0.1833

1 – 20 pairs of value are tied; 2 – 14 pairs of value are tied; 3 – 22 pairs of value are tied

Note: $H_a\mu_{M1-M2} < 0$; $H_0\mu_{M1-M2} = 0$

Table 4– Paired Wilcoxon result comparing Food and Nutrition Security's risk perception before and after the course

	FNS Pre-test Mean (M1)	FNS Post-test Mean (M2)	N	Statistics	p	Effect Size
Urgency[1]	4.17	4.22	29	05.00	0.074	-0.6429
Range[2]	4.36	4.50	29	06.00	**0.002**	-0.8857
Access[3]	3.94	3.97	29	14.50	0.100	-0.4727

1 – 22pairs of value are tied; 2 – 15 pairs of value are tied; 3 – 19 pairs of value are tied

Note: $H_a\mu_{M1 - M2} < 0$; $H_0\mu_{M1 - M2} = 0$

The results show that the increase of risk perception is not homogeneous between the themes either the axes of the ARP diagram. Students' risk perception in the PCOV theme had a meaningful change in the Access axis whereas GW and FNS themes had significant change in the Range axis; which shows that the course improved their knowledge about the COVID-19 Pandemics, whereas expanded their information to Global Warming and Food and Nutrition Security. For the other two axes of the ARP diagram in each theme we cannot assure statistically that the course has affected students' risk perception since there is not significant p-value (>0.05) or have low Effect Size value (below 0.3).

Also, in all three groups, it was observed that students changed their perceptions both in the theme in which they worked, as in the others. It can be noted that the justifications addressed aspects of the discussions held during the course activities. The FNS group showed the greatest increase in risk perception associated with its own theme. But this result was not repeated for the other two themes, since the GW group showed the greatest increase in the risk perception associated with COVID-19 and the increase in perception regarding global warming was not homogeneous between the axes, with GW group showing a greater increase in the axes of access and urgency, but in the axis of range was the FNS group.

CONCLUSION

The results obtained allowed us to conclude that the ARP diagram can be used as an assessment tool in teaching-learning situations. The technique we used to associate dimensions of the diagram with assertions and degrees of agreement allowed us to obtain a semi-quantitative indicator that represents the amplitude of students' risk perception. We were also able to verify that the course had a decisive effect in amplifying students' risk perception, and the production of the TLS allowed them to apprehend complexity of risk situations. Contrary to what common sense might indicate, there was no direct correlation between the topic studied and the increase in the perception of risk about it. Although it is only a preliminary result, risk perception should not be seen as a local skill. In other words, it does not work as in the solution of traditional problems where there is a delimited epistemological profile. The result obtained reinforces the idea that risk situations should be treated as complex problems and it is important to develop global skills of analyses and decision making.

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