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Perceptions of Selected Psychology Students about COVID-19: Investigations In Linear and Complexity Thinking

Brian Saludes Bantugan and Melvin Macuha
St. Paul University Manila

Abstract: The article underscores the increasing significance of complexity thinking in health education, specifically in the understanding of intricate healthcare systems and the differentiation between complex and complicated systems. It accentuates features like non-linearity and dynamic interactions inherent in complex systems. Using the COVID-19 pandemic as a case study, the article delves into the complexities and outcomes of this system, drawing a contrast with the linear thinking observed in responses to the pandemic. An 11-item online survey conducted among 29 psychology students investigated their perceptions of travel during the pandemic, revealing diverse viewpoints and distinctions in ethics, responsibility, accountability, and varied understandings of the pandemic's complexity. These findings highlight the necessity for psychology students to enhance their grasp of the social dimensions of public health and emphasize the importance of preparing them for potential ethical challenges in future healthcare decision-making, considering the variations in their perceptions. The study underscores the critical role of complexity thinking in health education, particularly in addressing real-world challenges such as the COVID-19 pandemic.

Keywords: COVID-19 pandemic, travel and tourism, psychology students, linear thinking, systems thinking, complexity thinking

I. Introduction

The assertion that measures like lockdowns, mask-wearing, and physical distancing, when independently implemented, would suffice to control COVID-19 infections reflects a lack of systems thinking and the prevalence of linear thinking (Ayouni, Maatoug, Dhouib, et al., 2021). These measures, following a step-by-step approach for public health protection, embody a linear perspective. Similarly, the phased return to normal business operations based on predefined criteria and schedules illustrates linear progression rather than complex thinking, Ayouni and associates added.

Moreover, vaccine development during the COVID-19 pandemic, which ideally adheres to a sequential and progressive multi-phase drug testing, implementation, and evaluation framework, suggests the institutionalization of linear thinking (Attwell, Rizzi, & Paul, 2022). Generalizations that stigmatize individuals who refuse vaccination by asserting their role in perpetuating the spread of the COVID-19 virus represent a unidirectional and simplistic approach to pandemic management, devoid of complex thinking (Patary, 2023).

The dearth of comprehensive information about COVID-19, coupled with lingering uncertainty, inclined more individuals toward linear thinking. Pietrangelo (2020) elucidated how fear, as described by the Yerkes-Dodson Law, can lead individuals toward linear thinking. Fear not only hampers problem-solving by constraining creative thinking but also prompts individuals to resort to tried-and-tested or default solutions.

Psychological theories such as Cognitive Load Theory (Sweller, 1988), Working Memory Capacity (Constantinidis&Klingberg, 2016), Attentional Control Theory (Coombes, Higgins, Gamble, Cauraugh, & Janelle, 2009), Cognitive Interference (Sarason, Pierce, &Sarason, 1996), Emotional Regulation (Gross, 2014), and Perceptual Narrowing (Cashion & DeNicola, 2011) offer insights into this inclination toward linear thinking during times of distress.

II. Pandemics as Complex Systems

In light of the foregoing, Fineberg (2020) contended that a pandemic should be viewed as a complex system because it inherently embodies complexity, characterized by the fact that the triggers and consequences of a pandemic exhibit intricate interdependencies with couplings that can be loose or tight, direct or indirect causations that are variously necessary, joint, conditional, and relative, feedback loops that may either amplify or dampen effects, and indeterminacies stemming from stochastic natural features and the limits of human understanding. In essence, all these attributes contribute to the definition of a system as "complex" (Fineberg, 2020). Notably, the complexity of the COVID-19 pandemic encompasses various dimensions, such as its identification as a disease, a public health concern, a challenge to the medical health system, an economic crisis, and a social issue. This complexity contrasts with the linear nature of infections, as observed by Smith and Karam (2018), who highlighted that "linear causality was the primary framework for comprehending the onset and progression of illnesses and distress" (Smith & Karam, 2018, para. 2). Braithwaite and colleagues (2021) similarly argued that healthcare management often operates on the basis of linear thinking, as many people assume that policy changes, quality improvement programs, procedures, test results, or new IT systems will be seamlessly implemented in frontline care, disregarding the multiple layers of complexity in healthcare (Braithwaite, Churruca, & Ellis, 2017, in Braithwaite et al., 2021).

III. Challenges posed by Linear Thinking

Siepe and Montgomery (2018) cautioned that linear thinking is primarily focused on addressing superficial "symptoms" rather than delving into the root causes behind these symptoms. This approach fails to recognize the time it takes for signals to propagate through a system, which means that the outcomes of an action may only become apparent much later, making it challenging to trace the origins of the results. Linear thinking tends to prioritize cost considerations over the optimization of throughput and often confuses the concept of price with that of value (Siepe& Montgomery, 2018, para. 4). Consequently, linear thinking in management falls short when it comes to anticipating disruptions and comprehensively understanding the dynamics within businesses operating in complex environments. Spaeth (2011) went so far as to assert that the prevailing linear paradigms in biology, health, and disease are insufficient for explaining many aspects of these fields (Spaeth, 2011). Similarly, Cornwall (2020) declared that linear thinking is no longer suitable for devising life plans or business strategies in the contemporary world (Cornwall, 2020). A study by Bantugan, Olivar, Sabayle, and Vitug (2023) pointed out that nursing students, while trained to think linearly in their discipline by default, did not manifest the use of such when confronted by a new phenomenon like the pandemic that does not seem governed by any present rules.

IV. Challenges to Cognitive Complexity

The National Academy of Engineering has pointed out that a significant factor contributing to "man-made disasters," such as the Fukushima Daiichi nuclear incident and the Deepwater Horizon oil spill in the Gulf of Mexico, is a limited comprehension of intricate human-technical systems, characterized by numerous interrelated components. Multiple research findings demonstrate that even highly educated engineers encounter challenges in grasping fundamental principles related to complex human-technical systems (National Academy of Engineering, in Knight, Grohs, Ghaffarzadegan, &Hosseinichimeh, 2018).To counter linear thinking, one

must develop towards cognitive complexity, defined as "the state or quality of a thought process that involves numerous constructs, with many interrelationships among them" (American Psychological Association, 2023, para. 1).

Cognitive systems are complex in that they exhibit emergence, nonlinearity, self-organization, and universality (Favela, 2020). And yet, there are barriers to non-linear and complex thinking. Fee, Gray, and Lu (2013) pointed out that greater interaction with complexity brought about greater cognitive complexity among expatriates in a longitudinal study. Jennings (2021) found that the cognitive complexity of nurses arises from their turbulent and unpredictable work. Sternberg and Ben-Zeev (2001) wrote that limited cognitive resources, cognitive biases and heuristics, emotional factors, such as stress or anxiety, lack of exposure to diverse perspectives and experiences, and cultural and societal factors that discourage critical thinking and exploration of alternative viewpoints are barriers to cognitive complexity. Altogether, they suggest that complexity begets complexity, and that non-linear thinking is a result of lack of experience in non-linear or complex phenomena.

V. Complexity Thinking during the COVID-19 Pandemic

Saurin (2020) explored the COVID-19 pandemic through the lens of Complexity Thinking (CT). CT, concerned with comprehending the dynamic interactions among a wide array of elements that constitute living systems (Cilliers, 1998, in Saurin, 2020), gives rise to emergent phenomena like pandemics. CT, defined by Braithwaite et al. (2018) as the application of systems thinking to complex systems (2018), becomes especially crucial when the gap between the complexity of a problem and human capabilities to address it widens (para. 4). Such is the case when mental health challenges emerged from the complex problems brought about by multi-level and often uncoordinated responses to the pandemic.

Saurin proposed that, through the CT lens, the pandemic should be perceived as a "natural-socio-technical system" responding to a biological pathogen. Accordingly, it requires management as a complex system using CT. While the COVID-19 virus itself is relatively simple and predictable, the pandemic represents an extreme illustration of non-linearity within complex systems, evident at three levels. These levels encompass the micro-level, involving personal lives, families, and the efforts of frontline pandemic responders, particularly healthcare workers and essential businesses. The meso-level accounts for the impacts on supply chains and organizations like hospitals, schools, and businesses. The macro-level encompasses societies on local, national, and international scales (Dekker, 2011; Song et al., 2006, in Saurin, 2020, para. 23).

In the realm of health education, CT has gained momentum as health educators and professionals have become increasingly cognizant of the limitations inherent in conventional linear approaches (Mennin, 2013). There is a growing trend toward interdisciplinary collaboration and the adoption of systems thinking to better address the intricate and interconnected nature of health (Rusoja et al., 2018). However, certain health education programs that embraced adaptive strategies faced challenges like resistance to change and resource constraints (Mirata, Hirt, Bergamin, et al., 2020). The integration of complexity thinking within health education has exhibited regional and institutional variations, often influenced by policy and institutional support, with some entities fully embracing it while others adhering to traditional models (Eray, 2021).

VI. Study Framework

Table 1, displayed below, illustrates the utilization of the DSRP (Distinction, System, Relationship, and Perspectives) model in a design process aimed at enhancing comprehension and delineation of a situation, pinpointing strategic points of influence, elucidating perspectives along with their underlying assumptions, and constructing a comparative framework for evaluating "two design approaches concerning complexity and the context of a wicked problem" (Zetterholm& Jokela, 2023, para. 18). The model in Figure 1 visually represents

'Perspective' as the "recognition of diverse mental frameworks." This is particularly significant within this context as it introduces the concept of the discord between an objective reality and the mental frameworks attempting to depict it for the purpose of knowledge development.

Table 1. *DSRP Model in a design process applied to a pandemic* (Zetterholm& Jokela, 2023)

Pattern	Pandemic
System (S)	Complex adaptive system. Root causes: pathogen–human interaction, human–human interaction. Subsystems and key parts in analysis: societal level; social level; pathogen, human hosts, preventive technologies.
Distinction (D)	Droplet spread of SARS-CoV-2 virus; infected and non-infected human hosts; contact tracing and nudging approaches.
Relationship (R)	Relations: human–virus; human–human; human–technology. Action–reaction: Primary prevention by nudging; secondary prevention by contact tracing.
Perspective (P)	Design perspective; awareness of different mental models; understanding the technologies.

As noted by VilliusZetterholm and Jokela (2023), epidemics and pandemics are characterized by swiftly changing and dynamic circumstances, where alterations occur in the physical realm (e.g., pathogens undergoing mutations), while simultaneously, our comprehension and knowledge advance rapidly. This engenders a multi-faceted and intricate scenario that poses challenges in terms of comprehension and management.

Figure 1, sourced from VilliusZetterholm and Jokela (2023), illustrates the presence of a continuum of knowledge variation between mental models and actual reality. It underscores the notion that individuals (those endeavoring to address real-world challenges using solutions crafted by designers) possess limited access to comprehending complex realities. Moreover, such understanding is primarily shaped by the mental models established by existing knowledge creators and designers striving to offer solutions for these challenges.

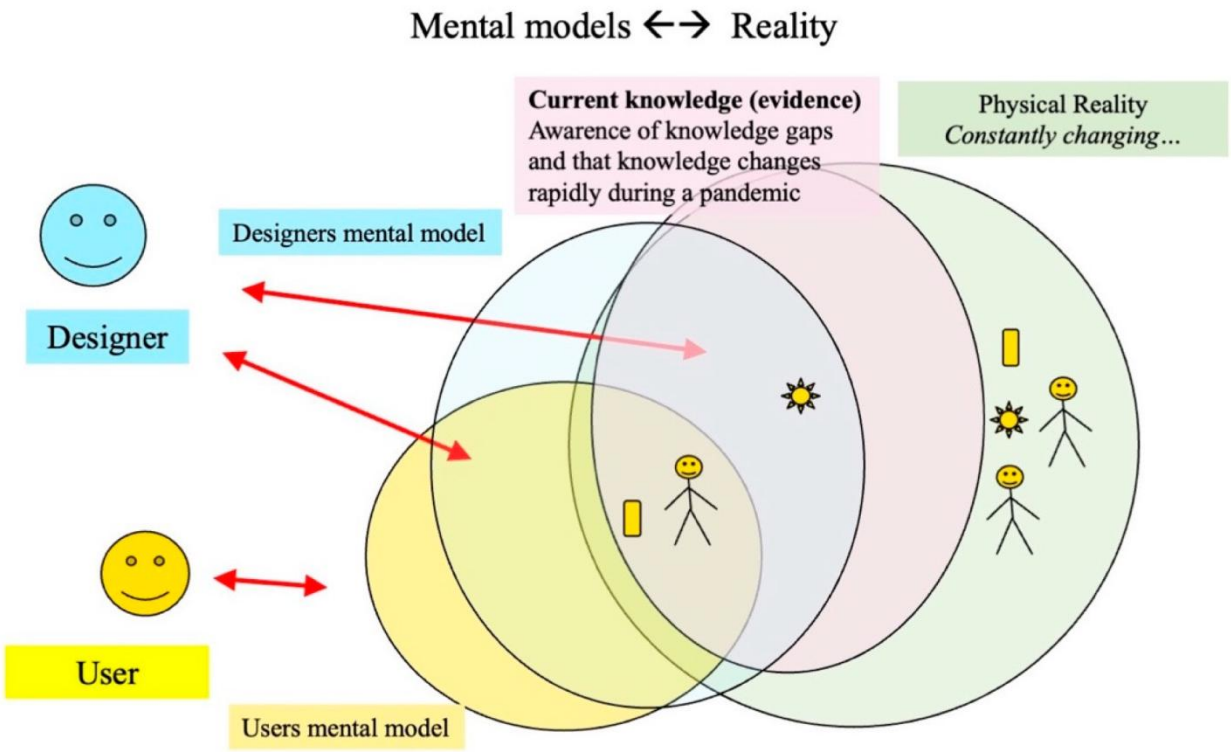

Figure 1. Continuum of knowledge of physical reality (Zetterholm& Jokela, 2023)

In this research, the term "user" refers to psychology students, and the "designers" are their educators or learning designers. The COVID-19 pandemic, given its interdisciplinary nature applicable across various courses, is especially pertinent as academic content for students in the field of health sciences. When applied within the context of this study, Figure 1 illustrates that psychology students' comprehension of the COVID-19 pandemic, as experienced within an educational setting, is significantly shaped by their instructors (designers). Consequently, the perceptions they hold regarding the pandemic, whether indicative of complexity thinking or not, primarily result from their formal education at the university. Consequently, their viewpoints reflect the presence or absence of complexity thinking within their academic programs.

VII. Statement of the Problem

This research examines the viewpoints of specific psychology students at St. Paul University Manila regarding matters related to the COVID-19 pandemic, specifically travel promotion during the first year of the quarantine period. Understanding these perspectives will enable the researchers to pinpoint disparities between the students' viewpoints and the growing significance of systems thinking within the healthcare system they aim to enter and contribute to.

VIII. Methodology

A survey consisting of 11 items administered through Google Forms, which included two demographic questions and nine psychographic inquiries, was conducted among 29 volunteerpsychology students (57% of 51) ranging from the first year to the fourth year within the College of Arts and Sciences at St. Paul University Manila during the second semester of the academic year 2022-2023. The nine psychographic items focused on the respondents' opinions regarding travel during the initial year of the quarantine mandate in the Philippines. Data analysis involved the use of descriptive statistics, and the findings were explored in the context of

complexity thinking. Perception gaps (PGs) were calculated by computing the differences in response distribution percentages, and these gaps were then translated into actual head counts, establishing a more tangible link between perceptions and individuals. Evidence of linear thinking was deduced from anticipated correspondences among closely related perceptions founded on established logical relationships. Perception gaps were interpreted as complexities inherent in the respondents' responses.

IX. Results

Data are presented in the following sequence: (1) Linear Thinking; (2) Inherent Complexity in Responses; and (3) Alignment with Complexity Thinking Statements.

X. Linear Thinking

Throughout the initial year of the quarantine in the Philippines, restrictions permitted only essential workers and front liners to venture outside their homes. Since students were engaged in online classes, there was generally no requirement to breach the government-mandated quarantine measures imposed within local communities. A significant proportion (75.8%) of the participants seldom or never departed from their residences, aligning with the government's directives. It is important to emphasize that students were not among the most vulnerable groups, and they had the option to venture outdoors if necessary, provided they possessed the appropriate documentation and adhered strictly to health protocols.

As quarantine measures were initially conceived as a strategy to minimize the risk of COVID-19 infections, the government's active promotion of local tourism, even as infection rates surged during both the first (Bantugan&Manguerra-Mahusay, 2021) and second (Bantugan, San Juan, Villanueva, Dumagat, &Ramagapu, 2023) trimesters of the initial year of lockdowns, was deemed incongruent with the principles supporting community quarantines. Consequently, a majority (86.2%) of the respondents believed that "it was inappropriate for the national government to encourage tourism and travel during the first year of the pandemic-related quarantine in the Philippines," and most of them (82.8%) held the perception that "quarantine mandates played a role in reducing COVID-19 infections."

Consequently, a significant portion of the participants (82.8%) held the perception that "even if the Department of Tourism encouraged them to do so," they "would not have considered local tourism travel during the first year of the community quarantine policy." Notably, a prevalent linear perspective emerged, with the majority of respondents (55.2%) believing that their discipline mandated them to adopt the position of "public health taking precedence over the economy." This sentiment was further reinforced by their shared belief (65.5%) in the relationship between travel and the spread of the COVID-19 virus, leading some of them (51.7%) to assert that "encouraging travel and tourism during the community quarantine period was an irresponsible action".

Table 2. *Statements reflecting linear thinking*

Item #	Perceptions	%
01	It was not right for the national government to promote tourism and travel during the first year of the quarantine period of the pandemic in the Philippines	86.2
02	I would not have considered traveling locally for tourism during the first year of the community quarantine policy even if the Department of Tourism encouraged him/her/them to do so.	82.8
03	Travel has something to do with the spread of the COVID-19 virus	65.5
04	The government promoting local tourism during the quarantine period of the first year of the pandemic in the Philippines should be held accountable for the increase in infections during that time	44.8
05	Public health first before economy	55.2
06	Promoting travel and tourism during the community quarantine period is irresponsible action	51.7
07	Community quarantine mandates helped reduce COVID-19 infections	82.8
08	Community quarantine mandates did not make me feel mentally healthier during the first year of the pandemic	72.4

Inherent Complexity in Responses

Given the above data, it is surprising that a majority of the respondents (55.1%) do not attribute or are unsure about the government's accountability on the rise of infections due to their promotion of local tourism during the initial year of the pandemic-related quarantine in the Philippines. They also demonstrate disparities, as evidenced by the distribution percentages, indicating a lower level of consensus among these viewpoints than anticipated. These variations in response distribution highlight that the respondents' uncertainties and disagreements regarding two typically aligned statements stem from underlying complexities.

Doing something not right (Item 01) **is not necessarily being irresponsible** (Item 06). The perception gap (PG) between the first statement (78.2%) and the second statement (56.4%) indicates that 34.5%, or 10 psychology students do not necessarily consider someone irresponsible solely based on their actions. The responses of the respondents highlight that, in theory, an individual's sense of responsibility may not always be evident in their behavior. Specifically, the responses indicate that 12 nursing students differentiate between the concepts of ethics and a sense of responsibility.

One need not be accountable (Item 04) **for the consequencesofdoing something not right** (Item 01). The perception gap (PG) of 41.4% highlights that 12 nursing students view accountability for the outcomes of unethical behavior as unnecessary. Consequently, this suggests that accountability can be separated from ethical conduct in this context.

Irresponsible action (Item 06) **need not call for accountability** (Item 04). The perception gap of 6.9%, which corresponds to 2 respondents, reveals that there are psychology students who do not anticipate

accountability for the outcomes of someone's irresponsibility. This implies that there are situations where acts of irresponsibility may not necessarily lead to a demand for accountability.

Prior to the intricate interconnection of ethics and accountability with one's sense of responsibility, the respondents' perceptions indicate a disentanglement of these elements among at least two out of the 29 psychology students, which is nearly one in ten. While the perception gaps may appear small, the underlying uncertainties and/or disparities in their answers suggest a departure from straightforward linear thinking. This is elucidated by the following items:

Perceiving that travel has something to do with the spread of the COVID-19 virus *(Item 03)* ***does not always correspond to perceiving travel promotion during quarantine as irresponsible*** *(Item 06)* - Four psychology students (equivalent to 13.8% PG) dissociates participation in the promotion of a perceived cause of viral spread from a lack of responsibility.

Perceiving travel promotion during quarantine is not right *(Item 01)* ***is not always associated with perceiving that travel has something to do with the spread of the COVID-19 virus*** *(Item 03)* - While most psychology students see promoting travel during a quarantine as unethical, six psychology students (accounting for a 20.7% perception gap) do not link this perception with the notion that travel contributes to the spread of the virus.

Perceiving that the government must be accountable for the consequences of promoting virus spread through travel *(Item 04)* ***is not always associated with the perception that public health should come first before the economy*** *(Item 05)* - While majority (16) of the psychology students think that public health should come before economy, three of them (equivalent to 10.4% PG) do not think that the government should be accountable for the negative impact of its travel promotion.

Perceiving public health should come before the economy *(Item 05)* ***does not always reflect the perception that promoting the economy through travel during the quarantine is irresponsible*** *(Item 06)* - One psychology student (equivalent to 3.5% PG) who perceived public health should be first priority did not perceive travel promotion during a quarantine period to be irresponsible.

Perceiving community quarantine mandates helped reduce COVID-19 infections *(Item 07)* ***does not align completely with perceiving community quarantine mandates were making people feel mentally healthier*** *(item 08).* Three psychology students (representing a 10.4% PG) who perceived that quarantine mandates were effective in reducing viral spread did not share the perception that these measures were beneficial for mental health. This suggests the view that quarantines are necessary to control the pandemic and prevent the need for extended quarantine periods, even if it negatively affects mental health.

Alignment with Complexity Thinking Statements

Respondents were most aligned with the statement “The pandemic is a complex problem requiring complex solutions” (82.8%). While data pointed out that psychology students agree with some linear thinking statements, they perceive the pandemic’s complexity, nonetheless. This is supported by another complexity thinking statement - “The pandemic is not just a medical issue but a social issue” (79.3%). The statement “Government’s pandemic action should be evaluated for improvement” (79.3%) may also be seen as entertaining the notion that, perhaps, the pandemic is not a simple problem of finding a vaccine as was highlighted during the pandemic; hence, an evaluation can lead to more complex problem-solving. Following at 65.5% alignment with respondents is the statement “Travel has something to do with the spread of the COVID-19 virus” which brings the understanding of the pandemic at the meso-level. At fifth is the statement “More

treatments should have been explored beyond vaccines" (58.6%), which opens the door for more complex problem-solving. Last among the statements that received more than half of the respondents' agreement is "Promoting travel and tourism during quarantine period is irresponsible" (51.7%) which is consistent with the data on travel contributing to the spread of the COVID-19 virus.

On the flip side of this data is 17.2% of psychology students (five persons) who have yet to acknowledge complexity in the pandemic, 20.7% (six respondents) not seeing alternative treatment possibilities outside of vaccination, and 34.5% (10 students) who have yet to accept that travel contributes to the global spread of diseases (Cetin & Kara, 2020). Altogether, at least one in six psychology students have yet to open themselves to complexity thinking that can help dispel the perception held by all respondents that the COVID-19 virus is the same as the pandemic.

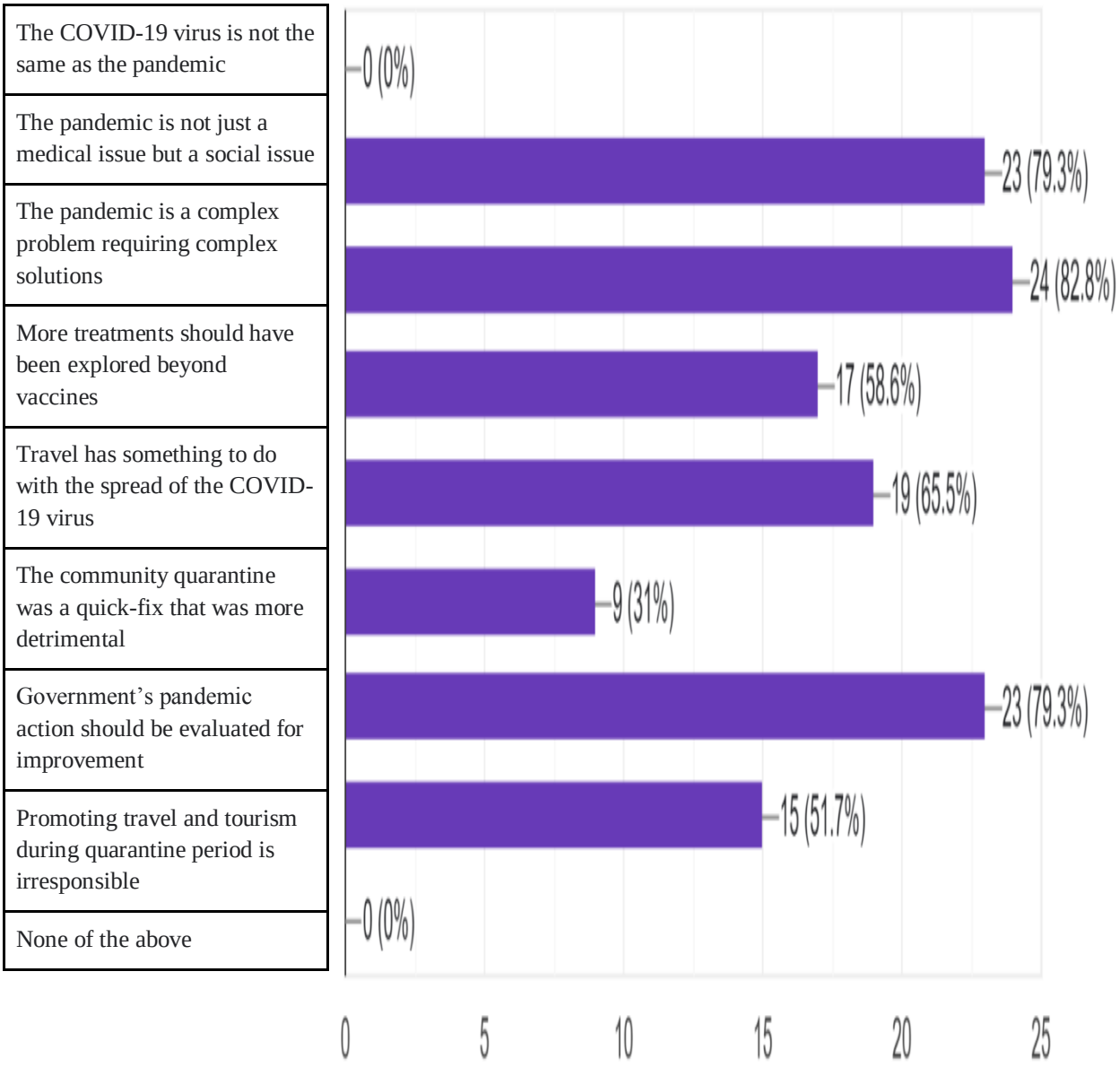

Figure 2. Respondents' Alignment with Complexity Thinking Statements

XI. Discussion

The data related to 'Linear Thinking' indicates that while the majority of the psychology students surveyed express agreement with statements based on linear thinking, a minority holds a differing view. This suggests that the formal academic curriculum may not uniformly shape the perceptions of these few students to align with the majority, or alternatively, they have encountered persuasive arguments that contradict the dominant viewpoints. In this context, it becomes apparent that the formal education of psychology students does not exert full influence over their perceptions regarding the COVID-19 pandemic, particularly in cases where linear and ostensibly rational thinking prevails.

Table 2 highlights that, with the exception of Item 04, eight statements reflecting linear thinking garnered strong agreement from the respondents. This demonstrates that the majority of the psychology students surveyed are notably inclined towards linear thinking when considering the pandemic, travel, and tourism, although to varying extents. The disparities in alignment signify differences in perception, which were quantitatively measured as PGs, revealing unique perspectives within a health sciences framework oriented towards linear positivist science thinking. Despite the increasing significance of systems thinking, rooted in complexity thinking, within healthcare systems, linear thinking continues to predominate in the interpretation of the pandemic. Notably, some respondents are yet to acquaint themselves with meso-level systems thinking in the context of disease transmission, underscoring the need for greater emphasis on the social aspects of public health, particularly at St. Paul University Manila among the participants surveyed.

The data within the 'Inherent Complexity in Responses' category bring to light perceptions that deviate from conventional linear and logical reasoning. Ethics, social responsibility, and accountability, typically treated as interconnected concepts, were observed as separate in the views of certain respondents, implying an independent perspective on how they perceive the world, irrespective of these conceptual linkages. Whether this independence of thought results from autonomous thinking, complexity thinking, or possibly misconceptions requires further comprehensive investigation. Regardless of the cause, the data unveil emerging uncertainties and discrepancies typically associated with complex phenomena.

The data in the 'Alignment with Complexity Thinking Statements' category revealed that the surveyed respondents acknowledge the complexity of the pandemic. However, all students did not distinguish between a virus and a pandemic, which likely contributed to their confusion about the pandemic at the meso- and macro-levels. The pandemic, seen as a natural rather than a social phenomenon, places the government in a merely reactive position, given its limited knowledge, to its natural unfolding. Consequently, it may be challenging to hold them accountable for their actions, particularly if those actions were presumably well-intentioned. In this context, the sense of responsibility must be separated from the usual expectations of accountability that appliedduringpre-pandemic times. This scenario poses an ethical dilemma that arises because the assumptions on which ethical decisions are based were suspended or rendered questionable during the pandemic. After all, it is the first time three or four generations experienced a ‘pandemic’ that was mired in misinformation, disinformation, and mal-information. Psychology students, with their diverse perspectives, should be prepared to collaboratively and competently make humane decisions alongside other healthcare professionals as future frontline workers during pandemics. Hence, addressing these ethical issues must be a critical learning experience for all students, not just psychology majors.

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