Adaptation of the Delphi Technique for Electronic Application in the Food Industry

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Abstract

Researchers often depend on humans to share their opinions, perceptions, experiences, or expertise concerning particular matters, which is a daunting task. As the impact of the 4th Industrial Revolution (4IR) continues to change the way we do things, electronic data collection is becoming a more viable alternative considering consumers' increased competence with modern technology. An electronic application of the Delphi technique that originated as a face-to-face or 'pen-and-paper' research technique is hereby presented as an up-to-date methodology and data collection tool that potentially holds many advantages across diverse disciplines. In the very dynamic foods and hospitality industry, where employment entails long and unconventional working hours, it is particularly challenging to pin employees down to participate in traditional data collection procedures where they are expected to complete tasks at specific times. An electronic application of the Delphi technique offers employees the opportunity to make valuable contributions to research in their own time and at their own pace. This paper reports on a successful electronic application of a classic Delphi procedure, involving South African food industry specialists, reflecting on the local context, aiming to optimize their expertise to elicit a context-specific definition for Food Literacy with all the associated dimensions.

Keywords: Delphi methodology, electronic research techniques, food literacy, 4th industrial revolution (4IR), food experts

Introduction

Certain issues that researchers wish to address are complicated by context-specific difficulties, which casts a shadow over the validity and reliability of research findings. For example, across the world, people are increasingly suffering from chronic, food-related non-communicable diseases (NCDs) as a consequence of a health and nutrition transition. Often, this burden arises with overweight and obesity (Wentzel-Viljoen, Lee, Laubscher & Vorster, 2018) that can be

linked to a shift away from freshly prepared home-cooked meals (Popkin, 2017). NCDs have therefore become a global quandary (Wentzel-Viljoen et al., 2018) that has attracted the attention of multiple scholars. At the core of the issue is food literacy, which is defined as a "set of skills and attributes that help people sustain the daily preparation of healthy, tasty, affordable meals for themselves and their families" (Desjardins & Azevedo, 2013:6). More specifically, food literacy is said to entail consumers' intertwined food-related knowledge, competencies, and behaviors, including food skills, the confidence to improvise and problem-solve, and the ability to access and share food-related information. These are enabled through external support factors such as access to healthy food, acceptable living conditions, broad learning opportunities, and positive socio-cultural environments that facilitate people's physical and psychological well-being (Desjardins & Azevedo, 2013). Ultimately, therefore, acceptable food literacy levels will empower individuals, households, communities, and nations to guide the quality and quantity of their dietary intake and will support dietary resilience over time (Rosas, Pimenta, Leal & Schwarzer, 2018; Vidgen & Gallegos, 2014).

The predicament for interventionists such as food and health practitioners, however, is that due to contextual differences, social and cultural complexities, food literacy per se is not a universal construct. Empirical evidence that consumers' food literacy levels could serve as a point of departure to empower them to refrain from behaviour's that are associated with the development of NCDs, is merely theoretical unless food literacy as an encompassing construct is properly defined with its related dimensions within a specific context. An abundance of literature that has been produced on the topic in recent years, has to date not yet produced satisfactory solutions in this regard. The first step in an encompassing endeavour to develop a measurement tool for people's food literacy in a South African context as a contribution towards the alarming increase in NCDs in the country (Nojilana, Bradshaw, Pillay-van Wyk, Msemburi, Somdyala, Joubert, Groenewald, Laubscher & Dorrington, 2016) hence required a unique, context-specific definition for the construct to be elicited (Fisher, Erasmus & Viljoen, 2019). This research, therefore, ventured into a twofold academic contribution. It firstly entailed the elicitation of a context-specific definition for food literacy that could be used by scholars and academics in South Africa in the future, utilizing an electronic application of the established classical Delphi technique for data collection, which has not been done before. Furthermore, the established definition for food literacy was used in the development of a measuring instrument to be used to determine levels of food literacy. While the definition for food literacy was meant to be context-specific, it was envisaged that the methodological procedure would be useful for future research across diverse disciplinary boundaries.

Literature review
Data collection in the digital era

Even though electronic data collection is not revolutionary in itself, it is bound to become increasingly popular among researchers in the future. Intrinsically, it holds many advantages despite indisputable disadvantages. The Fourth Industrial Revolution (4IR) has elevated the relevance of technology in people's lives, how data can be generated and analysed, and what effective communication entails (Lekhanya, 2019; Murugesan, 2013; Rabana, 2018). Researchers are particularly excited about benefits such as the opportunity to gain access to distant, and larger populations that would otherwise be difficult, expensive, time-consuming, and even impossible to achieve. Certain challenges that are associated with electronic data collection are unfortunately not always easy to overcome. Usually, response rates are low because people are not necessarily interested in a researcher's questionnaire that pops up in their mailboxes, especially if they have no connection or affiliation with its origin. Lack of motivation may also jeopardize potential respondents' participation in electronic surveys, apart

from being discouraged by connectivity issues and limited access to certain portals. Researchers, therefore, have to acquaint themselves with pertinent challenges when they introduce their request for participation to a potential target market, for example, respondents' lack of understanding of the questionnaire, and lack of opportunity to follow-up with non-responsive respondents if their anonymity is protected as part of ethical conduct (Rice, Winter, Doherty & Milner, 2017). Notwithstanding, improved access to the internet and increased use of personal smartphones – even in emerging economies (Ibrahim, Salisu, Popoola & Ibrahim, 2014) – make electronic data collection highly desirable. Undeniably, future research is likely to be dominated by digitization, collaboration across boundaries, as well as increased automation and interactivity (Bayode, van der Poll & Ramphal, 2019). Scholars will therefore have to transform and adapt. An adaptation of traditional "pen-and-paper" data collection methods, such as the Delphi technique, to be suitable for an electronic application, therefore seemed worthwhile.

Use of the Delphi technique in research

The Delphi Technique has proven itself as ideally suited to obtain trustworthy contributions from experts who can individually share their expertise to solve a complex problem (Landeta & Barrutia, 2011). The technique was originally developed for idea generation and evaluation (Goluchowicz & Blind, 2011) although it is often used to determine, predict, and explore group attitudes, needs, and priorities (Hasson & Keeney, 2011). It is typically used in subject-related research to measure people's understanding and judgment and to understand mental cognition (Linstone & Turoff, 2011). It is particularly useful to achieve consensus on a particular topic when various rounds of questions are presented to experts in a particular field as a multi-level, structured group interaction process (Chalmers & Armour, 2018). Usually, panel members who are experts in their respective fields provide numerical judgments during several iterations and receive anonymous feedback before proceeding to the next round (Goluchowicz & Blind, 2011). Because communication is emphasized, this technique is not merely a form of data collection. Rather, the iterative nature of the feedback process "develops an insight, which in its totality is more than the sum of the parts" (Day & Bobeva, 2005:104).

Inspiration for this investigation was the seminal work of Vidgen and Gallegos (2011), who involved Australian food industry experts in their very successful elicitation of a definition for food literacy almost a decade ago utilizing the normative Delphi technique. Of particular interest to this research, is that the Delphi technique has established itself as suitable to accumulate, assimilate and appraise the opinions of experts (Steinert, 2009) in many fields (Day & Bobeva, 2005; Frewer, Fischer, Wentholt, Marvin, Ooms, Coles & Rowe, 2011; Kauko & Palmroos, 2014; Knox, Shih, Warren, Gilardino & Anastakis, 2018; van de Linde & van der Duin, 2011) and that it has been used widely in recent years to select or develop indicators concerning particular phenomena (Liao & Lai, 2017). It hence provides a way for academics and practitioners to assess and combine human judgment in a structured manner (Rowe & Wright, 2011). In so doing, it can systematically and rapidly generate consensus among experts in a specific field (Brown, 2007; Heiko & Darkow, 2010) about a topic or subject where contradiction or controversy exists (Day & Bobeva, 2005), which this research identified with.

Delphi's history

The Delphi technique was developed in the 1950s by the US Rand Corporation for the United States Air Force, for application in strategic defence, whereafter it evolved to include scientific, educational and entrepreneurial research (Gnatzy, Warth, von der Gracht & Darkow, 2011; Heiko, 2012; Landeta & Barrutia, 2011; Linstone & Turoff, 2011; Romano, 2010; Skulmoski, Hartman & Krahn, 2007; Steinert, 2009). The evolution of the Delphi technique progressed in

five broad stages. It commenced with the *Period of Secrecy* (the early 1960s), post-World War Two, concerning weapons requirements; the stage of *Novelty* (1960s), when it was used to do forecasts; the period of *Popularity* (late 1960s and 1970s) when used for the evaluation of complex social problems related to health, transport, and the environment; the time of *Scrutiny* (1970 – 1980), characterized by criticism and defence of the technique; and lastly, *Continuity and Refinement* (1980 to present), during which the Delphi technique is acknowledged as a suitable methodology to address complex social issues (Donohoe & Needham, 2009). Over time, this technique has been applied in different ways to generate knowledge that may otherwise be difficult to achieve (Marchais-Roubelat & Roubelat, 2011). Unfortunately, it has not yet attracted enough attention to perfect it as a popular, trusted research tool.

Different forms of Delphi

Different forms of Delphi exist, and although it is highly likely that all may be applied electronically in the future (Hasson, Keeney & McKenna, 2000; Romano, 2010), a specific technique's fundamental rationale must be honoured (Heiko, 2012). Because of its expediency, email communication between the researcher and participants is beneficial for both parties. When efficient, it shortens the time required to perform Delphi surveys, which retains enthusiasm and encourages participation (Skulmoski et al., 2007) of larger samples across broader geographical areas. Recruitment costs, time for completion of the research, and storage processing can be reduced considerably, while respondents' anonymity and rapid feedback can be maintained (Goluchowicz & Blind, 2011; Hsu & Sandford, 2007a). Electronic surveys can be tracked more effectively, which is critical for the success of Delphi research (Romano, 2010). Notwithstanding, researchers may encounter challenges such as dealing with inactive email addresses, and respondents' inability to access stable internet connectivity (Donohoe & Needham, 2009). Table 1 summarizes different forms of Delphi concerning their application in former studies.

Table 1: Different forms of Delphi

Form of Delphi	Description	Reference
Exploratory-/ Conventional-/ Classical Delphi	A panel of experts is recruited to obtain reliable information about future trends concerning a specific issue or topic.	(de Soria, Durán, Morrás, González & Varela, 2018; Yousuf, 2007)
Modified Delphi	The conventional Delphi technique is modified, e.g. by allowing in-person discussion among some of the experts, even at the end of the process, noting the value of face-to-face meetings to exchange views, clarify reasons for disagreements, and resolve uncertainties.	(Bleijlevens, Wagner, Capezuti, Hamers & Workgroup, 2016; Griffey, Schneider, Adler, Capp, Carpenter, Farmer, Groner, Hodkins, McCammon & Powell, 2020)
Spatial Delphi	This applies when consultations and related decisions concern matters of spatial location. Experts' contributions are geographically mapped, and convergence of their opinions is indicated utilizing simple geometric shapes (circles or rectangles). During subsequent iterations, the shapes become progressively smaller to circumscribe a very small portion of territory that represents the final solution to the research problem.	(Di Zio, 2018; Di Zio & Pacinelli, 2011)
Policy-/ Focus-/ Decision Delphi	Used to explore different policy options with the most important pros and cons for each policy resolution based on experts' judgments, opinions, and experiences.	(Linstone & Turoff, 2011; Paraskevas & Saunders, 2012; Yousuf, 2007)
Real-time-/ Consensus Conference-/ Normative Delphi	This refers to an online computer-mediated asynchronous conference system where anonymity is guaranteed.	(Linstone & Turoff, 2011; Yousuf, 2007)
E-Delphi (eDelphi), Technological-/ Online- / Argument Delphi	A modified Delphi survey was conducted online.	(Hasson & Keeney, 2011; Taylor, Feltbower, Aslam, Raine, Whelan & Gibson, 2016)

Disaggregating Policy Delphi	This format is based on the assumption that consensus is not possible through expert communication, but will evoke various schools of thought because experts aggregate around the alternative arguments that gain support.	(Tapio, Paloniemi, Varho & Vinnari, 2011)
Problem Solving Delphi	Used for collaborative judgment by collecting participants' rankings or paired comparisons.	(Linstone & Turoff, 2011)
The Fuzzy Delphi Method (FDM)	Information obtained is expressed as fuzzy numbers, instead of a single value in traditional deterministic methods.	(Manoliadis, 2018)

Delphi operations

All Delphi procedures are similar, although the reason for the research will determine the operational style or particular form of Delphi. In essence, the Delphi technique represents a normative group technique (NGT), although group members are not required to be physically present while iterations between experts and the researcher (as the facilitator) continue (Yousuf, 2007). Theorists caution that the Delphi technique should follow a detailed predetermined procedure to sustain the quality of the research (Brown, 2007). The procedure entails a series of questionnaires that are completed by experts in a particular subject field that are interspersed by controlled feedback to the experts during several iterative rounds (Hasson & Keeney, 2011). Anonymity is retained as individuals get to see the aggregated feedback and not only their own. The first round generally serves to generate ideas that are used to structure questions for subsequent rounds. This round is generally a free-flowing unstructured investigation of the study domain and includes the establishment of criteria for the selection for participants, the identification of the Delphi panellists (or experts), construction of the data collection and analytical procedures, and extraction of the issue that needs to be tested during the subsequent rounds (Day & Bobeva, 2005). Although some argue for some preparatory development before the start of this round, the development process is not necessarily a separate stage. This pre-stage can be either exploratory or confirmatory, as shown in step 1, Figure 1 that presents the general flow of the Delphi process. In Steps 2 to 6, every round of responses is analysed, revised, and reissued for refinement (Romano, 2010), quantitatively, thematically, or through a combination of both before responses are returned to participants, accompanied by the subsequent round of questionnaires (Brown, 2007). In Step 7, the last round, the equilibrium distribution (such as arithmetic mean in a consensus situation) is calculated and presented as a final approximation (Steinert, 2009).
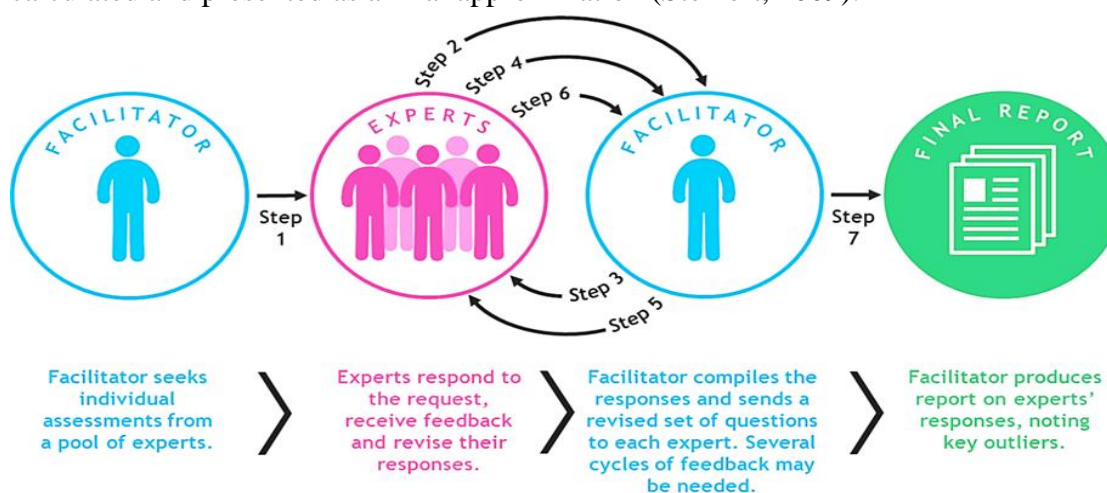

Figure 1: Delphi Technique (Edwards & Fellows, 2016)

The Delphi method is particularly useful to mitigate challenges that are associated with the generation of the group response. The key features of the Delphi technique are summarized in Table 2.

Table 2: Characteristics of the Delphi technique

Characteristic	Explanation
Anonymity	Participants remain anonymous, eliminating influences within the group (Habibi, Sarafrazi & Izadyar, 2014). Participants are unaware of which comments originate from whom (Linstone & Turoff, 2011). Participants have no contact with other participants and are not influenced or dominated by any authority or other individuals in the group (Hsu & Sandford, 2007a). Participants are never influenced to change their original viewpoints (Liao & Lai, 2017). Perceptions about others who are of higher social or professional standing that could constrain free expression of opinions are avoided (Hsu & Sandford, 2007a; Liao & Lai, 2017).
Controlled feedback	The researcher provides controlled feedback between rounds to share all participants' perspectives, allowing participants the opportunity to clarify or change their views if they are not happy with how their responses have been captured (Skulmoski et al.., 2007). Conformity pressure exerted by majorities or dominant individuals can be managed (Goluchowicz & Blind, 2011). Feedback can be provided in various ways such as statistical measures of central tendency such as mean or median and a measure of dispersion such as standard deviation (Hanafin, Brooks, Carroll, Fitzgerald, GaBhainn & Sixsmith, 2007) as well as statistical summaries of panel judgments, deduced feedback or arguments with numerical estimates (Goluchowicz & Blind, 2011). Adjusting data between successive feedback rounds enhances a more accurate answer to the research question (Brender, Ammenwerth, Nykänen & Talmon, 2006). Multiple iterations orient participants to become more problem-solving and to offer well-deliberated opinions, "and to minimize the effects of noise" (Hsu & Sandford, 2007a).
Statistical group response	Data analysis can be qualitative and quantitative. Statistical aggregation of group response allows for quantitative analysis and interpretation of data (Ecken, Gnatzy & Heiko, 2011; Hohmann, Angelo, Arciero, Bach, Cole, Cote, Farr, Feller, Gelbhart & Gomoll, 2020; Skulmoski et al.., 2007). Statistical analysis reduces possible conformity through group pressure, ensuring that individual opinions are accommodated in the final iteration (Hsu & Sandford, 2007a).
Iteration	A Delphi method could include between two and ten operations, although two or three rounds are more common (Goluchowicz & Blind, 2011) and even a single round may suffice (Day & Bobeva, 2005). Iterations are terminated when: the research question is answered; consensus is reached; theoretical saturation is achieved; stable and accurate judgments have been received, or when sufficient information has been exchanged (Goluchowicz & Blind, 2011; Skulmoski et al., 2007). The iterative nature of the Delphi process, combined with feedback to respondents, elevates the potential of the Delphi process in comparison to other survey approaches (Frewer et al., 2011).
Expert participants	Delphi allows access to a wide pool of knowledge and experience (Romano, 2010), therefore the selection of experts is critical, as their opinions dictate the entire Delphi output (Day & Bobeva, 2005; Goluchowicz & Blind, 2011). Experts may include top management decision-makers, professional staff members with their support teams, or knowledgeable others (Hsu & Sandford, 2007a; Paraskevas & Saunders, 2012) who possess expert knowledge of the topic of investigation (Hasson et al., 2000) based on people's level of experience, qualifications and exposure to the problem being investigated (Hasson & Keeney, 2011). Experts should have the capacity, be willing to participate, and should have good communication skills to critically engage and articulate their thoughts and opinions about the subject (Hsu & Sandford, 2007a). Some research recommends the inclusion of lay-persons in the panel to avoid possible bias and legitimize acceptance of the study's findings in broader society. Hussler, Muller and Rondé (2011) however caution that the level of expertise dramatically influences participants' opinions in subsequent iterations. Participants must be chosen on the premise that they will contribute different, and even unorthodox opinions (Bolger & Wright, 2011). Since participants are not selected randomly, representativeness is not assured (Hasson et al., 2000).

	Even though the involvement of experts or knowledgeable participants is the norm for inclusion in a sample when using the Delphi technique, personal bias should be prevented (Hasson & Keeney, 2011).

Methodological considerations

Consensus/ Agreement

Delphi is a structured group communication process and not a method that necessarily aims to achieve consensus. Rather, the number of rounds should be determined by the stability of the responses (Linstone & Turoff, 2011). 'Consensus' implies 'opinion stability', which refers to reaching collective agreement among participating experts after iterative rounds that have entailed sequential questionnaires with controlled feedback in-between interpretation of the experts' opinions (Donohoe & Needham, 2009). The consensus method is generally used where other methods that rely on objective information are not plausible (Landeta & Barrutia, 2011) and where the researchers aim to explore possible consensus among experts. It may for example require experts to rate a specific aspect (Meijering, Kampen & Tobi, 2013).

The consensus is mostly determined through a statistical measurement of variance in responses, where lower variance implies greater consensus (Hanafin et al., 2007). While Delphi studies may be conducted to achieve consensus or agreement among a group of topic specialists or experts, a concise interpretation of the meaning of consensus or agreement is not clear (Meijering et al., 2013). A measurement of the percentage of votes that fall within a prescribed range is commonly used to assess consensus. This can be done through two tests to test the stability of participants' vote distribution over successive rounds. Also, participation numbers should not fall below a critical level of between ten and 15 participants in a homogenous group, or at least seven (Day & Bobeva, 2005). A pertinent concern emanates from the reduction in the variance of opinions over subsequent rounds and whether this would then truly reflect consensus. For example, 'false' consensus can stem from the drop-out of participants who were discouraged because they feel that their responses were ignored (Paraskevas & Saunders, 2012).

The literature recommends that the measure of acceptable group consensus should be predetermined, for example, that 60% agreement is sufficient to claim agreement between panellists, or a measure of inter-quartile range, where no more or less than 10% deviate from the median in any direction (Donohoe & Needham, 2009). The percentage of agreement required to claim consensus is particularly important in Normative Delphi. Certain studies propose very explicit percentage cut-off points that need to be specified at the beginning of the study, for example, 51%, or 80% consensus. Other studies use an arbitrary cut-off to limit the number of items that are considered (Paraskevas & Saunders, 2012). A post-group consensus where experts individually express their agreement with the final group aggregate (participants' final round rating and the ratings of other participants) can also be used (Paraskevas & Saunders, 2012). Some studies suggest that consensus is reached when 80% of the replies fall within two categories of a 7-point scale, or at least 70% on a 4-point Likert-type scale where the median should be higher than 3.25 (Hsu & Sandford, 2007a).

Number of rounds or iterations

Every round of questionnaires requires a feedback process where the researcher works through participants' responses to a particular round to accumulate a statement/s that represent/s the position of the whole group (Hsu & Sandford, 2007a). After each round, participants get the opportunity to reassess their initial judgments. The number of rounds/Delphi iterations depends on various aspects, such as the time available, whether the research requires one round to feed into the next, and of course, if consensus was reached. However, fatigue may jeopardize the outcome if the researcher is overly enthusiastic and presents too many rounds, particularly

when participants are already pressurized for time, such as in the hospitality industry (Hasson et al., 2000).

For classical Delphi, three iteration rounds are generally suggested to reach consensus. However, when the sample is homogenous, fewer rounds may suffice to reach consensus, theoretical saturation, and/or to uncover sufficient information (Skulmoski et al., 2007). Knowing when to discontinue the rounds is crucial. If terminated too soon, the results may not be meaningful, while too many rounds may cause sample fatigue and a waste of resources (Hasson et al., 2000). There should always be sufficient reason for a subsequent round (Landeta & Barrutia, 2011). The number of rounds largely depends on when stability in the responses is attained, notwithstanding the nature of responses (Linstone & Turoff, 2011). This is deemed a more reliable indicator of consensus than percentage calculations (Hasson et al., 2000). Often, a third round is a duplication of the second round, except that panellists would have received the results of the second round (Romano, 2010). Scholars may feel that this final round is important to confidently disseminate a final report.

Attrition

Attrition refers to the incidence when participants quit before they have completed all the rounds for whatever reason, such as lack of time, distraction between rounds, disillusionment, or when they simply do not feel that their contributions are worthy (Donohoe & Needham, 2009). Researchers, therefore, have to attend to all the factors that may discourage participants from completing every round as it is equally important to maintain a high response rate in the first, as well as in subsequent iterations (Hsu & Sandford, 2007b).

Outliers and minority opinions

Although the Delphi technique strives to attain a centralized opinion, it allows for instances where pertinent outliers are evident after iterative rounds of investigation, as well as that it might even be impossible to reach consensus (Donohoe & Needham, 2009). Outliers that may lead to a false consensus should also be acknowledged, monitored, and reported because a consensus outcome should never be forced. Diversity of opinion is inevitable among groups of people. Eventually, the subjective sharing of opinion among members between rounds for comment enhances the quality and objectivity of the data, as well as the credibility of the research findings. If outliers and minority opinions remain after feedback to participants, they should not simply be ignored or discarded.

Rigors of design

The Delphi method should be subjected to the same rigors of design as any other form of research, including triangulation, research transparency, and reliability checks of coding (Brown, 2007) because methodological rigor is the cornerstone of good research, whether quantitative or qualitative (Skulmoski et al., 2007). The researcher should therefore consciously attend to the trinity or "Holy Grail" of reliability, validity, and trustworthiness which implies a critical review of all the procedures that are followed during the research process (Hasson & Keeney, 2011).

The Delphi procedure incorporates characteristics of both positivistic quantitative as well as interpretive qualitative research. Some prefer to adopt qualitative strategies to ensure credibility (Hasson & Keeney, 2011). With the Delphi technique, reliability and generalizability of outcomes are ensured through the iteration of rounds during data collection and related analyses that are guided by the principles of democratic participation and anonymity (Day & Bobeva, 2005). Rigor can be improved utilizing a clear audit trail of

decisions of all the theoretical, methodological, and analytical decisions throughout the research process (Skulmoski et al., 2007).

The rationale for using Delphi to elicit a definition for food literacy
This study aimed to develop a context-based definition for food literacy, and specifically opted for the Delphi technique as it is often used to explore complex and uncertain concepts in areas where theory is lacking (Skulmoski et al., 2007). The Delphi technique provokes researchers to make a paradigm shift away from a reductionist, linear analysis that has limited application in complex, inter-related issues of the 21st century social and biological sciences such as food literacy (Brown, 2007). The Delphi technique was used, because:

- Traditional face-to-face research methods posed logistical challenges to involve experts across the country.
- It is an inclusive, flexible, and reflexive process that facilitates rather than forces consensus.
- Experts could be selected based on their closeness to the subject, without geographic limitations (Donohoe & Needham, 2009).
- A heterogeneous panel of experts could be invited to increase the variety of viewpoints (Hanafin et al., 2007; Rowe & Wright, 2011).
- Communication could be controlled through the researchers' feedback between each iteration (Meijering et al., 2013).
- Experts could change their opinions during iterations without negative consequences because feedback is done anonymously (Meijering et al., 2013).
- More accurate data is generated because participants complete the tasks on their own without interference, even if it is contradicting, without feeling embarrassed (Du Plessis & Human, 2007), which enhances the quality of ideas (Donohoe & Needham, 2009).
- Anonymity encourages honest contributions that is free from criticism (Donohoe & Needham, 2009).
- The Delphi technique is relatively inexpensive and resource-efficient, producing relatively rapid responses that eases the administrative workload of the facilitator/researcher (Bolger & Wright, 2011).
- The iterative process generates reliable outcomes that are generalizable, provided the participants were selected well (Donohoe & Needham, 2009).
- This particular Delphi exercise fed into a subsequent development of a measurement instrument for food literacy, including an item generation process (Skulmoski et al., 2007).

Methodology
The different rounds
Generally, the research problem guides the choice of a specific type of Delphi technique. This research project opted for the Classic Delphi procedure that traditionally aims to elicit opinion and gain consensus through approximately three iterations. The first round comprises an open qualitative round that allows panellists to spontaneously respond to selected prompts (Hasson & Keeney, 2011), aiming for a "framework-driven" initial round (Yücel, Oldenhof, Ahmed, Belin, Billieux, Bowden-Jones, Carter, Chamberlain, Clark & Connor, 2019). This Delphi technique provides a way to integrate anonymous experts' knowledge through their diverse and often subjective judgments, opinions, and experiences to achieve consensus. Because South Africa has a unique and diverse population, a confirmatory approach was considered. The first round hence explored what the concept entails in terms of relevant and related sub-concepts.

Even though the Delphi techniques allow more flexibility and freedom of interpretation than many other research methods, certain procedures and rules should be honoured (Donohoe & Needham, 2009). This research was structured as follows: The Scoping round (Partoredjo, 2019) entailed an extensive literature review to acknowledge experiences gained from previous research. Round one (1), the "Exploration" round, entailed spontaneous responses to open-ended questions to generate ideas that could be addressed in subsequent rounds. These questions had to be well-phrased and clear (Hasson et al., 2000) and therefore a preliminary questionnaire was compiled and a pre-test was done (Falzarano & Zipp, 2013). Qualitative feedback from this preliminary exercise was used to generate a comprehensive list of relevant concepts and an initial definition that could be used in the subsequent round (Brender et al., 2006). Round two (2), the so-called "distillation stage", entailed a final questionnaire that was generated based on participants' feedback from the preliminary questionnaire (Brender et al., 2006). The amended version that contained modified and clarified concepts and definitions were mailed to the same experts with a request to respond to questions (Falzarano & Zipp, 2013). Participants could revise their contributions after comparing their responses to that of other group members (Di Zio & Pacinelli, 2011). This round served as a repeat attempt at opinion-seeking with subsequent analyses to establish when the Delphi research could be terminated (Day & Bobeva, 2005). The quantitative analyses included a calculation of means and medians on the content of the revised definitions to calculate opinion convergence. Although not a strict rule, many studies use 80% to indicate agreement on a matter. Round three (3), the distinct "unitization stage", is reached when all the objectives are met after Round 2 and when the outcome is presented to participants for comment. In this study, Round 3 implied the use of the results from Round 2 towards the development of a food literacy measurement scale.

Sampling method and size

A purposive sampling technique was used to select an initial sample that was not representative of the general population but rather consisted of experts that could make a worthy contribution to the research question (Skulmoski et al., 2007). Non-probability snowballing was used to expand the sample: the initial list of experts was asked to nominate additional experts for possible inclusion (Habibi et al., 2014; Rowe & Wright, 2011). The recruitment criteria for food experts in this research required participants to hold a professional position in the South African food, nutrition, and hospitality industries, involving a group of experts who were well trained and competent in the specialized area of foods and nutrition (Habibi et al., 2014). The aim was to involve respondents from across many different fields of expertise within the South African food industry to incorporate a diversity of inputs. Selected participants had to be able to define and operationalize concepts and dimensions related to food literacy.

The panel of experts selected for this research project was homogenous in principle, in that they were all experts in the food and nutrition industry. However, their involvement in different sub-categories of the food and nutrition industry meant that their focus differed, which potentially contributed to the diversity of contributions (multidisciplinary background) (Donohoe & Needham, 2009; Rezk, Radwan, Salem, Sakr & Tvaronavičienė, 2019). Being an electronic procedure, the Delphi technique allowed the inclusion of participants notwithstanding their geographic location.

The Delphi technique does not limit the number of expert participants included on a panel. Generally, the scope of the problem and the available resources guide such a number. Previous studies reported the inclusion of between 10 to more than 1600 participants (Habibi et al., 2014; Paraskevas & Saunders, 2012). The joint effort of participants rather than the

number of participants influences the quality of the results (Brender et al., 2006). An initial database of 272 possible participants was identified for this study.

Data analysis and results

Statistical analysis entailed qualitative coding of constructs and a statistical summary in terms of means and medians plus upper and lower quartiles (Skulmoski et al., 2007) to provide insight into the group of participating experts, and to guide the development of the second iteration that involved the assessment of the Food Literacy definition. Round one (1): An introductory email accompanied the Round 1 field protected Excel questionnaire (see Addendum 1). Participants were informed of the aim of the research, the time that would be required to participate, as well as how communication would take place (Donohoe & Needham, 2009). Possible participants in the group were reminded that willing participants had to commit to all the Delphi iterations for the data to be functional, also emphasizing the value of their participation in terms of South African food and nutrition literature. Participants could nominate others who might be willing to participate through a process of co-nomination (Frewer et al., 2011), which produced an additional 33 names and contact details. The 305 invitations were considered adequate for the initial round, taking into consideration the possible low response rate.

The demographic information collected from food experts in Round 1 were captured in an Excel document and imported into SPSS for analysis. The sample included an adequate distribution of experts (N = 76) across the various food-related fields. Additional information, such as occupation, years in practice, qualifications, and self-reported indications of their knowledge regarding food and nutrition were captured. Although controversial, self-rating on an ordinal scale is an accepted method to establish the level of expertise levels of participants (Goluchowicz & Blind, 2011). The sample constituted 76 food experts, with an average of 18.98 years of experience (SD 11.12 years) in their respective fields. They were therefore considered eminently qualified to participate in the exercise. Most experts (78.9%) possessed a tertiary qualification, while less than 10% were trained in-service. Participants' subjective evaluation of their knowledge about food and nutrition, respectively, on a ten increment Agreement scale, indicated that the group regarded themselves more knowledgeable about food (Mean 7.44; SD 1.33) than nutrition (Mean 6.93; SD 1.67).

Participants spontaneously formulated a definition for food literacy in their own words, and extracted core sub-concepts from their definitions, ordering them in terms of the level of importance of inclusion in a definition. The data was content-analysed by the researchers, and similar concepts were grouped. Alternative terms for certain concepts were grouped where they fit best. This process was done following the existing literature. Research accentuates that it goes against the basic tenets of Delphi to omit infrequently occurring items although it is important to reduce large amounts of data that may cloud consensus (Hasson et al., 2000). The first-round contributions produced the following definition for food literacy: *"Food literacy refers to an individual's knowledge, skills, and behaviour as demonstrated through the sourcing, consumption as well as the nutritional, economic, safety and social aspects of food".* Six sub-concepts emerged, namely:

- Procurement (sourcing) – competence to wisely acquire (obtaining, buying, purchasing) from available accessible food sources.
- Financial (economics) – competence in terms of their own financial ability to wisely acquire (buying, purchasing) from available accessible food sources without wastage
- Consumption – competence to make informed choices in the planning, preparation, and eating of meals, inclusive of competencies to correctly store and cook food, interpret and adapt recipes, and use of relevant equipment.

- Nutrition – competence to address health and well-being by incorporating competencies related to the selection, preparation, and consumption of health-promoting foods and practices.
- Food safety – competence in food safety when handling, preparing, and storing food in ways that will prevent foodborne illnesses.
- Social – competence to consider cultural and ethnic differences, trends, entertainment value, and status in food choices.

Round two (2): This round produced feedback from 71 food experts despite reminders. The retention rate of 92,2% was very encouraging, considering other studies (Frewer et al., 2011) that failed to get more than 64% returns after Round 1. Attrition is measured between Round 1 and 2. In this study, the number of participants had not yet been confirmed at the Scoping Round. This iteration provided an opportunity where participants could verify their first-round responses, and, having viewed a summary of all other participants' responses, to change or expand their former responses (Skulmoski et al., 2007).

Second-round data were captured in an Excel document, and imported into SPSS for analysis. Participants indicated their level of agreement with the accumulated definition on a scale from 1 to 10, also indicating on a four increment scale how relevant they considered the listed constructs, i.e. their endorsement of the constructs (Kronk, Colbert, Smeltzer & Blunt, 2020). Each section provided the opportunity for participants to comment on further refinement in a comment box (Kauko & Palmroos, 2014). Even though panellists were not encouraged to omit ratings, some found certain aspects beyond their scope of knowledge and chose to rather not rate certain sections (Alexander, Science, Breakey, Clarke & Gibson, 2020). Bolger and Wright (2011) explain that this way of eliciting rich reasoning from participants provides excellent cues of what the truth is. The mean level of agreement with the stated definition was Mean 8.43 (Max = 10; SD 1.54), while the agreement with relevance of the sub-concepts and their domains (Max = 4) were: Procurement (sourcing): Mean 3.63 (SD 0.59), Economics: Mean 3.41 (SD 0.73), Consumption: Mean 3.54 (SD 0.61), Nutrition: Mean 3.57 (SD 0.70), Food safety: Mean 3.61 (SD 0.67), and Social: Mean 3.37 (SD 0.81). Despite the opportunity to make amendments to first-round contributions, no noteworthy changes were indicated. The stability of the panel after completion of Round 2 was considered adequate, with less than 10% attrition (Thorn, Brookes, Ridyard, Riley, Hughes, Wordsworth, Noble, Thornton & Hollingworth, 2018).

Round three (3): Based on the second-round results, where levels of consensus with the definition and sub-concepts were good, it was decided that additional rounds would be superfluous, and these metrics were carried forward (Bunch, Allin, Jolly, Hardie & Knight, 2018). Essentially the first two rounds provided all the required information to formulate a definition for food literacy for the South African context, specifying sub-concepts and their domains. The aim of this research was therefore met. It is proposed that if highly skilled experts are included in the exercise, one is more likely to obtain good first-round predictions, and panellists are less likely to change their initial assessment (Goluchowicz & Blind, 2011).

Because the Delphi technique should preferably feed into ensuing research, the outcomes of this investigation were optimized for the development of scale items for inclusion in a food literacy measurement instrument for South Africa. Rather than to embark on a formal Round 3, participants were asked to willingly contribute scale items in an additional round for inclusion in a food literacy scale that is reported in a subsequent publication.

Enhancing reliability, validity, and trustworthiness

The three aspects of reliability, validity, and trustworthiness are understood to be the three pertinent criteria for judging a research project's worth, while rigor can be maintained by

documenting the audit trail, as well as using more than one researcher to analyse and document decisions made during the process. Reliability refers to an instrument's ability to produce similar consistent results when repeated under similar conditions, as well as the stability of the measurement over time, and similarity of measurements obtained within a given period (Hasson & Keeney, 2011). The number of iterative rounds during the Delphi process enhanced the reliability of this work, as it allowed food experts to verify an aggregate of participants' contributions and provided an opportunity for participants to reconsider their contributions and to make amendments if they wanted to. The food expert panel size that commenced with 76 and ended up with 71 participants was a relatively large group in the homogenous field of food, with sufficient heterogeneity to cover a large part of the operational fields of food, hospitality, and nutrition. The fact that participation in this work was democratic and that attempts were made to include the top experts of the respective sub-fields within the food world enhanced the reliability of the data. Finally, the fact that total anonymity was ensured during all the rounds, and that the expert panel never met face-to-face or knew who the other panel members were, eliminated group bias and undue influencing, which also contributed to reliability (Shariff, 2015).

Validity is generally described as the extent to which a method measures what it is intended to measure, and comprises face and content validity. These represent measures to establish whether the instrument is measuring the appropriate concepts and determines if the instrument adequately covers the topic of investigation (Hasson & Keeney, 2011). It is a subjective judgment whether the instrument measures what it intends to measure in terms of the relevance and presentation of the questionnaire (Shariff, 2015). For this research, all the communications (emails), as well as the accompanying questionnaires were thoroughly scrutinized by the primary researcher and peers in the academic field. The questionnaires were further proof-read for readability, clarity of content, and language to ensure unambiguity and clarity (Shariff, 2015). One respondent commented after Round 1 that the original Likert-type scales of the questionnaire did not indicate that 0 (zero) implied "least" and 10 indicated the "most". This omission was rectified in a follow-up email. Participants who wished to change their initial responses were invited to do so, but nobody used this opportunity. Content validity refers to panel members' judgments concerning the extent to which the content of the measuring instrument seems to reasonably address the characteristics of the field that is being explored (Shariff, 2015). The content validity of this research was enhanced by constant referral to existing publications on food literacy, by careful and meticulous analysis of Round 1, as well as the inclusion of expert participants whose contributions to the topic would be valued. Round 2 allowed participants to review and amend the content and therefore the information was disclosed for scrutiny by all. Construct validity for this research was ensured through a rigorous assessment of the theoretical foundations of Delphi methodology. Two types of criterion-related validity (when a test is shown to be effective in predicting criteria or indicators of a construct) can aid in the methodological rigor, namely concurrent and predictive criterion-related validity (Hasson & Keeney, 2011). Lessons were also learned from an Australian study (Vidgen & Gallegos, 2014) that had employed the Delphi technique to extract a food literacy definition for application in the Australian context.

Trustworthiness comprises four aspects, namely credibility, dependability, confirmability, and transferability. Dependability is ensured through the use of iterations so that participants have an opportunity to amend their opinions, as well as fidelity to the methodology by rigorously keeping an audit trail. Credibility relates to the degree of the believability of the data based on the ability of the researcher to exercise wise research decisions, sensible actions, and to eliminate potential bias in the research. Confirmability represents the degree to which other researchers, when using the same data, would reach the

same conclusions. Transferability refers to the application of the findings to other settings in a way that other experts in the same field would admit that the results concur with their experiences (Hasson & Keeney, 2011; McPherson, Reese & Wendler, 2018). In this research, a strong consensus among the participants on the outcomes indicates that the findings of the study can be confidently communicated.

Significance/Interpretation
Even though some criticism of the Delphi technique may still exist, it could be as a result of researchers' failure to adequately execute the method, rather than the methodology itself (Hohmann, Brand, Rossi & Lubowitz, 2018). The collective experience and contributions of food experts in this study confirmed the merit of this technique as a tool to explore other topics in related domains. In this study, this investigation focused on the use of the Delphi technique to elicit a definition for food literacy, which in itself paves the way for noteworthy research in the future. Per se, this research indicates how the Delphi technique can be used to, rather effortlessly and affordably, gather valuable data across a broad geographic area provided the methodology is applied meticulously in terms of recruitment of the sample, instructions, clarity of communication, and pedantic data analysis.

Conclusion
In this paper, the authors promote the use of the Delphi technique in electronic format for multiple reasons, namely possible wide application, affordability, and speed of the process. This paper highlights the characteristics of the Delphi technique in response to recent trends to opt for electronic procedures in a digital era, and then demonstrates how the electronic technique was applied to develop a definition for food literacy in a South African context. Entering into the period of the 4th Industrial Revolution, the electronic use of the Delphi technique is also in line with scholarly considerations of 4IR. It provides a viable opportunity for different stakeholders in the foods and nutrition domains, who may be geographically far apart, and who may not have the research funds to initiate a research study, to share their perspectives on important phenomena electronically in a fairly uncomplicated manner. In doing so, important perspectives could be integrated for publication to benefit a broader audience. In many ways such inputs may be overlooked or lost, because it often seems impossible to connect, communicate, and interpret individual experiences. The Delphi technique provides a plausible avenue where role players from various disciplines could join strengths to ensure that important opinions, perceptions, experiences, or expertise concerning particular matters are shared without major financial implications. For example investigations into the challenges that the recent COVID-19 pandemic has confronted us with. During the pandemic, hospitality, tourism and leisure industry operators have had to reinvent themselves to sustain their businesses. Delphi provides the ideal way to share the experiences and insights gained during this time, and preserve the evidence for future generations to benefit from. Imaginative researchers are needed to identify and optimise these opportunities that the Delphi technique offers as presented in this paper.

This empirical research, like many other research projects, is not without limitations. A prime reason for not pilot testing the initial questionnaire was that this research followed a similar Australian study to develop a food literacy definition (Vidgen & Gallegos, 2014). The findings are primarily based on the evaluations of experts with a background in a variety of food-related fields and industry professionals that also included subject-matter experts and organizations from politics, associations, and academia, which may have partially compensated for any bias (Roßmann, Canzaniello, von der Gracht & Hartmann, 2018). The literature further suggested an exploratory workshop before Round 1 to increase response rates in subsequent

rounds (Frewer et al., 2011), which was not considered viable based on logistical challenges and recommendations in the aforementioned Australian study. Rather, open-ended comments were allowed in Round 1. A possible limitation of the research technique is that it relied on experts' contributions (Merlin, Young, Starrels, Azari, Edelman, Pomeranz, Roy, Saini, Becker & Liebschutz, 2018). However, the final food literacy definition that guided the development of a food literacy measurement instrument, is meant to be applied and used by food and nutritional experts to determine food literacy levels of individuals that could be used to guide and educate food-related interaction in a society.

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