


The Role of Novelty Satisfaction in Distance Physical Education During the COVID-19 Pandemic: A Self-Determination Theory Perspective

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Abstract

Purpose: To better understand the role of novelty satisfaction in distance physical education (PE) during the COVID-19 pandemic, this study aimed to determine the relationships among students' novelty satisfaction, basic psychological needs satisfaction, autonomous motivation, effort, and enjoyment and to examine the mediating effects of autonomous motivation in the relationships between novelty satisfaction and effort and enjoyment. **Methods:** The participants were 332 undergraduate students from 10 PE classes. Structural equation modeling was used for data analysis. **Results:** Satisfaction of students' need for novelty and the three basic needs positively predicted autonomous motivation, which in turn positively predicted effort and enjoyment. The relationships between students' novelty satisfaction and their effort and enjoyment were mediated by autonomous motivation. **Conclusion:** This study provides important insights into needs satisfaction and motivational

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underpinnings of outcomes in distance PE during the COVID-19 pandemic. We suggest that future studies develop novelty support strategies based on our findings.

Keywords

Autonomous motivation, basic psychological needs, coronavirus disease, distance learning, need for novelty

With educational systems critically impacted by the epidemic of coronavirus disease 2019 (COVID-19), many campuses have been forced to shut down in order to minimize virus spreading via interpersonal contact (Crawford et al., 2020; Flores & Gago, 2020). Given this context, distance learning was suggested as a replacement for on-site learning (Sintema, 2020). Notably, physical education (PE), which depends mainly on in-person interactions between educators and students, is more severely hindered by the COVID-19 pandemic. Although certain technologies have been used as tools to enhance students' learning, these tools cannot and are not meant to replace actual instruction in person (Crawford & Fitzpatrick, 2015; Hung & Chen, 2016; Pill et al., 2019). Varea and González-Calvo (2020) reported that some physical educators have faced substantial obstacles and setbacks amid the COVID-19 pandemic because of the lack of direct contact with students. In addition, students are more likely to feel bored since there are minimum interactions with their peers, or they may be inactive in class when in-person instructions from educators are lacking in distance PE (Liu, 2001). Distance PE amid the COVID-19 pandemic may be expected to result in less enjoyment when group learning is lacking and physical activities are greatly limited. Students' efforts may also be compromised by a lack of direct interaction with teachers and peers. Hence, determining how to effectively facilitate students' learning, such as improving their enjoyment and effort in distance PE during the COVID-19 pandemic, is a critical issue.

Recent PE studies have found that novelty satisfaction played a crucial role in students' learning (González-Cutre & Sicilia, 2019; González-Cutre et al., 2016). Novelty is defined as the perception of an individual when encountering something not previously experienced or something deviating from his or her daily routine (González-Cutre et al., 2016). To date, research exploring novelty satisfaction is primarily based on self-determination theory (SDT) which was proposed by Ryan and Deci (2017). In the SDT framework, novelty is considered to be another basic psychological need among the original needs for autonomy, competence, and relatedness (González-Cutre et al., 2016, 2020). González-Cutre and Sicilia (2019) reported that students' novelty satisfaction impacts several important PE outcomes, such as vitality, flow, and satisfaction, through students' intrinsic motivation. Though these studies contributed greatly to examining the importance and mechanisms of novelty satisfaction, the influences of novelty satisfaction on learning outcomes in distance PE remain unknown in the COVID-19 context, where students have insufficient interpersonal interactions.

Given the lack of evidence, the present study was proposed to determine how novelty satisfaction has functioned in distance PE during the COVID-19 pandemic.

Need for Novelty in SDT

Self-determination theory posits that the cognitive, affective, and behavioral consequences for an individual are influenced by his or her motivation continuum (Deci et al., 1996; Ryan & Deci, 2017). The motivation continuum includes intrinsic motivation, different forms of extrinsic motivation (i.e., integrated, identified, introjected, and external regulation), and amotivation based on the level of self-determination (Ryan & Deci, 2017). Autonomous motivation (i.e., intrinsic motivation, integrated and identified regulation) was associated with positive outcomes such as effort and positive attitudes, whereas amotivation and controlled motivation (i.e., introjected regulation and external regulation) were associated with negative outcomes such as displaying boredom as well as withdrawing effort (Curran & Standage, 2017).

Basic psychological needs (i.e., the need for autonomy, competence, and relatedness) are the other essential element in the SDT framework. Self-determination theory also posits that the individual's motivation continuum is affected by the level of satisfaction of his or her psychological needs (Ryan & Deci, 2017, p. 239). Specifically, the need for autonomy is the need to determine one's own actions or participation in certain activities; the need for competence is the need to strive for a sense of achievement or success; and the need for relatedness is the need to have satisfactory and harmonized interpersonal relationships or to perceive oneself as belonging to the social environment (Deci & Ryan, 2002). According to Ryan and Deci (2017), needs satisfaction leads to autonomous motivation as well as adaptive consequences, whereas needs frustration leads to amotivation and controlled motivation as well as maladaptive consequences.

In SDT, the needs for autonomy, competence, and relatedness have been considered as forming the three basic psychological needs (see Vasconcellos et al., 2020). Recently, González-Cutre et al. (2016) proposed novelty as a basic psychological need and made new contributions to the development of SDT. In their research, González-Cutre et al. reviewed abundant SDT literature and surmised that novelty should be viewed as one of the basic psychological needs and a crucial factor for intrinsic motivation. Their results supported the new proposal that novelty could be considered a basic psychological need and provided a validated scale to measure its psychometric properties and predictive validity. Aligned with these findings, González-Cutre et al. (2020) examined whether novelty can be an additional need in SDT with samples from the general public (individuals aged 18 to 80 years), and the two-phased study provided solid support for novelty as an additional need. Furthermore, a recent study (González-Cutre & Sicilia, 2019) showed that novelty satisfaction is a significant predictor of intrinsic motivation, vitality, flow, and satisfaction in PE classes. In this SDT-centered study (González-Cutre & Sicilia, 2019), novelty satisfaction was also viewed as one of the basic psychological needs and could predict outcomes through the mediation of motivation. In general, novelty has received preliminary support to be considered a

basic psychological need. Along these lines, these studies not only provided evidence to support the importance of novelty satisfaction but also revealed a new direction needing further exploration.

Novelty Satisfaction, Effort, and Enjoyment in PE

Effort and enjoyment were chosen as the outcomes in the present study because they are considered the essential objectives of PE at all learning stages (Lund & Tannehill, 2014). The importance of effort and enjoyment is also confirmed in some mainstream PE instruction models; for example, effort is one of the five responsibility levels expected to be achieved by students in the model teaching personal and social responsibility (TPSR; Hellison, 2011) and is assumed to be the foundation of higher-level responsibility (e.g., to be transferred outside the gym). Moreover, in the sport education model, enjoyment is viewed as a necessity for students during the learning process and a determinant index for confirming model effectiveness (Hastie et al., 2011; Wallhead et al., 2013). In addition to their intrinsic importance in PE, the roles played by effort and enjoyment in PE amid the COVID-19 pandemic are even more significant. Currently, studies examining students' effort and enjoyment in PE under the framework of SDT have unanimously supported the mechanism by which psychological needs affect outcomes through the motivation continuum (see Vasconcellos et al., 2020). In general, a student's motivation continuum is influenced by the extent to which his or her psychological needs in the PE context are satisfied (Van Den Berghe et al., 2014; Vasconcellos et al., 2020). More specifically, the better the student's psychological needs are satisfied, the greater his or her autonomous motivation can be, leading to a high level of effort (e.g., Hein & Caune, 2014; Hsu, Pan, et al., 2014) and enjoyment (e.g., Yli-Piipari et al., 2012; Zhang, 2009).

Several studies have examined the relevance of novelty satisfaction, effort and enjoyment in non-PE contexts. For example, studies on general education (e.g., Martin et al., 2013) and corporate organization (e.g., Sansone et al., 1992) showed that novelty satisfaction could predict a high level of engagement. González-Cutre et al. (2020) also reported that students' novelty satisfaction was positively correlated with their enjoyment. In addition, studies on mobile game experiences (e.g., Merikivi et al., 2016) and the experiences of tourists in visual facilities in amusement parks (Butts, 1993) suggested that enjoyment could be predicted by novelty satisfaction. These findings indicated that novelty satisfaction has positive linear relationships with effort and enjoyment.

Need for novelty was proposed as a candidate basic psychological need in SDT (see Vansteenkiste et al., 2020). Previous SDT studies (González-Cutre & Sicilia, 2019; González-Cutre et al., 2020) have provided the initial finding that satisfying the need for novelty has positive consequences (e.g., vitality and flow) through the path of autonomous motivation. That is, the role of novelty satisfaction in the hierarchical model "needs satisfaction → motivation → positive outcomes" in SDT has been preliminarily supported. However, little is known about whether novelty satisfaction can predict effort and enjoyment through the path of autonomous motivation in distance

PE contexts. In addition, studies conducted amid the COVID-19 pandemic are even scarcer, suggesting that this issue should be examined in an empirical study.

The Present Research

The empirical evidence on the effects of novelty satisfaction in the PE context and the even rarer findings produced amid the COVID-19 pandemic are clearly insufficient. To expand the existing knowledge and increase opportunities for practical application, this study aimed to examine the relationships among students' novelty satisfaction, satisfaction of three basic psychological needs, autonomous motivation, and outcomes such as effort and enjoyment in PE. The mediating effects of autonomous motivation on the relationships between novelty satisfaction and effort and enjoyment were also tested. Based on the review of previous studies, we hypothesized that students' novelty satisfaction and the satisfaction of three basic psychological needs could positively predict autonomous motivation, which could in turn positively predict effort and enjoyment. We also hypothesized that the relationships between students' novelty satisfaction and their effort and enjoyment could be mediated by autonomous motivation.

Methods

Participants and Procedure

The participants were undergraduate students from 10 PE classes at a university in (Taiwan). As required by the university, all undergraduate students have to take part in two 50-minute compulsory PE classes every week for four semesters. This university is one of the few universities that implemented distance teaching instead of closing the campus amid the COVID-19 pandemic. The research team administered the questionnaires during the first in-person PE class after the epidemic abated. A total of 384 questionnaires were distributed. There were 332 valid participants with an average age of 20.59 ± 1.38 years. The response rate was 86.46%. These participants were 174 male students (52.41%) and 158 female students (47.59%).

The period of distance PE was 12 weeks, and Microsoft Teams was used as the tool. A total of four physical educators implemented the distance teaching activities in these 10 classes. All instructors had participated in an eight-hour distance teaching training program. In this distance PE, all the physical educators adopted the direct instruction method. Bodyweight exercises, cardiovascular exercises, and exercise knowledge were taught in accordance with the PE curriculum.

This study was approved by the university's board committee. After consent forms were obtained, the students were briefed on the research purposes and instructed on how to complete the questionnaire. Before the students completed the questionnaires, PE teachers were asked to leave so that the students could complete the questionnaires without feeling any pressure.

Measures

Basic Psychological Needs. The Basic Psychological Needs in PE Scale (BPN-PE; [Vlachopoulos et al., 2011](#)) was used to measure the students' satisfaction with regard to autonomy, competence, and relatedness needs. [Hsu, Chou, and Pan \(2014\)](#) translated this scale into Chinese and reported evidence of its reliability and validity in Taiwan. This scale includes 12 items, four for autonomy (e.g., "We do things that are of interest to me"), four for competence (e.g., "I feel that I improve even in the tasks considered difficult by most of the students"), and four for relatedness (e.g., "My relationships with my classmates are very friendly"). The participants were asked to rate each item on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The internal consistency reliability values for the three types of needs in this study were 0.89, 0.89, and 0.88, which were within the ideal range.

Novelty Satisfaction. The Novelty Need Satisfaction in PE Scale (NNSS, [González-Cutre et al., 2016](#)) was used to measure the satisfaction of the students' need for novelty. This scale includes 6 items (e.g., "I feel I do novel things"). [Hsu and Pan \(2021\)](#) translated this scale into Chinese and changed the item response options from a 5-point Likert-type scale to a 7-point Likert-type scale. Sufficient evidence for its reliability and validity was also provided. Therefore, the participants were asked to rate each item on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The internal consistency reliability value in this study was 0.90, which was within the ideal range.

Autonomous Motivation. The perceived locus of causality scale, which was revised for the PE context ([Standage et al., 2006](#)), was adopted in this study. The scale consists of five subscales: intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. [Hsu, Chou, and Pan \(2014\)](#) translated this scale into Chinese and reported evidence of its reliability and validity in Taiwan. Following previous studies (e.g., [Jeno et al., 2019](#); [Rutten et al., 2015](#)), autonomous motivation was calculated based on the respondents' mean scores for the four-item intrinsic regulation subscale (e.g., because PE is fun) and the four-item identified regulation subscale (e.g., because it is important for me to do well in PE). The participants were asked to rate each item on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The internal consistency reliability values in this study were 0.88 (intrinsic regulation) and 0.86 (identified regulation), which were within the ideal range.

Effort. Students' effort in PE was assessed using the effort subscale of the Students' Responsibility in Physical Education Scale (SRIPES; [Hsu, Pan, et al., 2014](#)), which includes 4 items (e.g., "I focus on learning"). The original items of the SRIPES are Chinese. The participants were asked to rate each item on a 6-point Likert scale ranging

from 1 (strongly disagree) to 6 (strongly agree). The internal consistency reliability value in this study was 0.91, which was within the ideal range.

Enjoyment. The revised scale for measuring students' enjoyment in the PE context (Sparks et al., 2017) was used in this study. This scale includes four items (e.g., "I have fun in PE lessons"). Hsu et al. (2021) translated this scale into Chinese and reported evidence of its reliability and validity in Taiwan. The participants were asked to rate each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The internal consistency reliability value in this study was 0.93, which was within the ideal range.

Data Analysis

In the preliminary analysis, all data were subjected to accuracy screenings and descriptive analyses via the Statistical Package for the Social Sciences (SPSS) for Windows 20.0 software package. In the main analysis, we conducted structural equation modeling (SEM) with maximum likelihood estimation using the AMOS 18.0 program. In accordance with the suggestions for SEM analysis (Jackson et al., 2009), the comparative fit index (CFI), root mean square error of approximation (RMSEA), and Tucker-Lewis index (TLI) were chosen for the model fit indices. The recommended values for each index were CFI >0.90, TLI >0.90, RMSEA <0.08, and SRMR <0.08 (Browne & Cudeck, 1993; Byrne, 2001; Marsh et al., 2004). To determine the statistical significance of the mediated pathways, the bootstrapping approach described by Preacher and Hayes (2008) was employed for calculating the indirect effects and their 95% confidence intervals. The recommended index for significance is a 95% confidence interval that does not contain zero (MacKinnon et al., 2002).

Results

In this study, we test (a) whether satisfying students' need for novelty and three basic psychological needs could positively predict autonomous motivation, which in turn could positively predict effort and enjoyment, and (b) whether the relationships between students' novelty satisfaction and their effort and enjoyment were mediated by autonomous motivation. In the preliminary analysis section, we present the results in terms of descriptive statistics and correlations. In the main analysis section, we present the results of the measurement model, structural model, and mediation effects.

Preliminary Analysis

For all the items, the skewness and kurtosis were within ± 2 and met the assumption for a normal distribution (Marshall & Mardia, 1985). Table 1 shows the means, standard deviations, and Pearson correlation coefficients for novelty satisfaction, autonomy

Table 1. Descriptive Statistics and Pearson Product-Moment Correlations.

	Range	Mean	SD	2	3	4	5	6	7
1. Novelty	1–7	5.00	1.09	.49	.35	.51	.53	.55	.52
2. Autonomy	1–7	4.61	1.21		.45	.55	.52	.56	.54
3. Competence	1–7	4.42	1.26			.57	.49	.50	.51
4. Relatedness	1–7	4.60	1.14				.56	.60	.56
5. AM	1–7	5.16	1.23					.60	.59
6. Effort	1–6	4.21	1.21						.63
7. Enjoyment	1–5	3.80	.92						

** = $p < .001$.

Note. AM = Autonomous Motivation;

Range = The range of mean for each variable.

satisfaction, competence satisfaction, relatedness satisfaction, autonomous motivation, effort, and enjoyment.

Main Analysis

Measurement Model. The results of the measurement model indicated an acceptable fit ($\chi^2 = 794.59$, $df = 506$, $p < 0.05$; TLI = 0.96; CFI = 0.97; RMSEA = 0.04; SRMR = 0.04). In this model, all factor loadings were significant, indicating that the measures of the model were appropriate. As shown in Table 2, the factor loadings for all items were greater than 0.45. All the AVE values were greater than 0.50, while all the composite reliability (CR) values were greater than 0.60. Thus, all values met the suggested criteria (Bagozzi & Yi, 1988; Jöreskog & Sörbom, 1989).

Structural Model. The analysis showed that the hypothesized structure displayed an acceptable fit ($\chi^2 = 810.85$, $df = 507$, $p < 0.05$; TLI = 0.96; CFI = 0.97; RMSEA = 0.04; SRMR = 0.04). As the path analysis results show in Figure 1, the standardized path coefficients between novelty satisfaction and autonomous motivation, effort, and enjoyment were .29*, .21*, and .21*, respectively; the standardized path coefficients between autonomy and autonomous motivation, effort, and enjoyment were .16*, .16*, and .16*, respectively; the standardized path coefficients between competence and autonomous motivation, effort, and enjoyment were .20*, .14*, and .17*, respectively; the standardized path coefficients between relatedness and autonomous motivation, effort, and enjoyment were .21*, .23*, and .16*, respectively; and the standardized path coefficients between autonomous motivation and effort, and enjoyment were .22* and .22*, respectively. In general, these results supported the research hypotheses.

Mediation Effects. As shown in Table 3, autonomous motivation played significant mediating roles between novelty satisfaction and effort (0.02, 0.14) as well as between novelty satisfaction and enjoyment (0.02, 0.06) given that all paths were significant and

Table 2. Summary of the Measurement Model.

Construct	Item	FLs	CR	AVE	Construct	Item	FLs	CR	AVE
Novelty Satisfaction	No1	.72	.89	.59	Autonomous Motivation	AM1	.76	.95	.71
	No2	.82				AM2	.81		
	No3	.71				AM3	.82		
	No4	.81				AM4	.90		
	No5	.75				AM5	.89		
	No6	.78				AM6	.80		
Autonomy Satisfaction	Au1	.85	.89	.68	Effort	AM7	.89	.91	.72
	Au2	.76				Ef1	.81		
	Au3	.87				Ef2	.86		
	Au4	.81				Ef3	.87		
Competence Satisfaction	Co1	.86	.89	.69	Enjoyment	Ef4	.85	.93	.78
	Co2	.81				En1	.90		
	Co3	.85				En2	.87		
	Co4	.79				En3	.90		
Relatedness Satisfaction	Re1	.82	.88	.66		En4	.88		
	Re2	.82							
	Re3	.79							
	Re4	.81							

Note. FLs = Factor Loadings; CR = Composite Reliability; AVE = Average Variance Extracted.

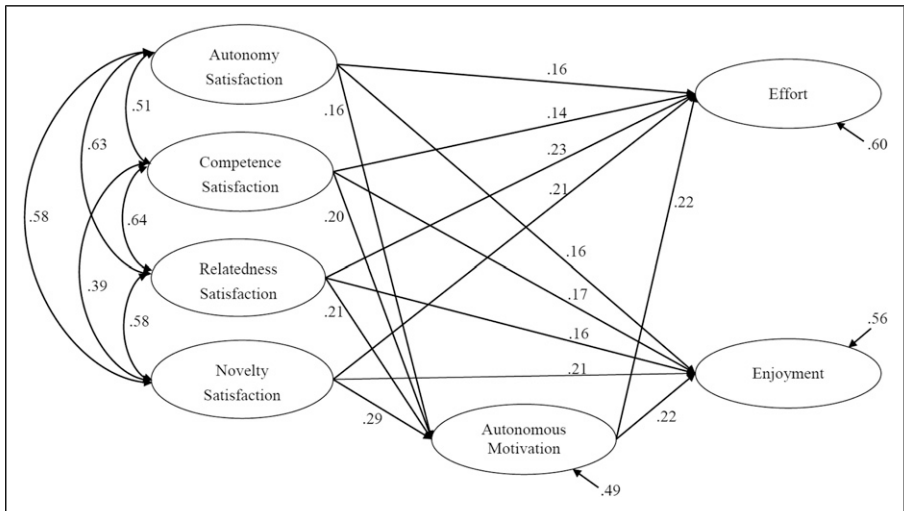


Figure 1. Structural model with standardized path coefficients.

Table 3. Summary of the Mediating Effect.

	Mediating effect	95% Confidence interval		<i>p</i> value
		Lower	Upper	
Novelty satisfaction → autonomous motivation → effort	.06	.02	.14	.001
Novelty satisfaction → autonomous motivation → enjoyment	.06	.02	.16	.001

the 95% confidence interval did not contain zero (MacKinnon et al., 2002). Thus, the hypotheses for mediation effects in this study were also supported.

Discussion

The present study focused on how novelty satisfaction works in distance PE during the COVID-19 pandemic. Considering SDT (Ryan & Deci, 2017), we investigated a hierarchical model that encompassed the following hypotheses: First, the satisfaction of students' need for novelty and three basic psychological needs could positively predict autonomous motivation, which could in turn positively predict effort and enjoyment. Second, the relationships between students' novelty satisfaction and their effort and enjoyment could be mediated by autonomous motivation.

Unsurprisingly, satisfaction with three basic psychological needs (i.e., autonomy, competence, and relatedness) positively predicted autonomous motivation, which in turn positively predicted effort and enjoyment. The findings are consistent with the theoretical tenets of SDT (Ryan & Deci, 2017). Previous PE studies (see Van Den Berghe et al., 2014) comprehensively explained how satisfying students' basic psychological needs would be associated with greater autonomous motivation and further impact the positive outcomes in PE (e.g., effort and enjoyment). Our findings also suggested that although actual interactions were limited amid the COVID-19 pandemic, the satisfaction of students' needs for autonomy, competence, and relatedness remained crucial to obtain positive outcomes in PE.

As hypothesized, novelty satisfaction positively predicted autonomous motivation. This result echoed the findings of pioneering studies examining novelty satisfaction in PE (González-Cutre & Sicilia, 2019; González-Cutre et al., 2016). As stated by Deci and Ryan (2002), individuals tend to have genuine pleasure in the activities they find novel and fun or tend to view such activities as valuable. Furthermore, González-Cutre et al. (2016) posited that novelty satisfaction and intrinsic motivation are closely connected since engaging in new activities in a new environment triggers positive motivation responses. One of the elements of intrinsic motivation is to experience stimulation (participating in an activity for the feelings of excitement and sensory and

aesthetic pleasure) (Banack et al., 2011), and novelty satisfaction is one of the essential factors to activate this element; therefore, it is understandable that novelty satisfaction and autonomous motivation are closely connected.

Notably, novelty satisfaction is better able to predict autonomous motivation and enjoyment than satisfaction of the other three basic psychological needs. This finding may be explained by the drastic changes in the classroom ecosystem brought about by distance teaching, wherein both educators and students are experiencing an unprecedented “teaching and learning” process due to the COVID-19 pandemic (Flores & Gago, 2020; Sintema, 2020). Students may feel an even greater gap in distance PE since they are now deprived of onsite practice and interactions (Varea & González-Calvo, 2020). In such a context, novelty satisfaction may play an even more important role in learning. Students may have more intrinsic motivation and perceive enjoyment when novel elements are integrated into classes to satisfy students’ need for novelty in distance PE. In addition, novelty satisfaction can predict effort second only to the predictive power of relatedness satisfaction, which may partially be affected by the countermeasures adopted by universities amid the COVID-19 pandemic. In the sampled university, abundant measures of caring were adopted to promote students’ health and encourage them to be highly involved in learning in all kinds of classes (including PE). Hence, in this current study, relatedness satisfaction was found to have the best predict effort.

Our findings that the relationships between novelty satisfaction and effort and enjoyment in PE were mediated by autonomous motivation are also consistent with our hypothesis. In line with SDT (Ryan & Deci, 2017) and prior novelty-based research in PE (e.g., González-Cutre & Sicilia, 2019), the role of the need for novelty is similar to the role of the other three psychological needs in SDT. Students’ novelty satisfaction encourages autonomous motivation and further produces adaptive outcomes, such as effort and enjoyment. Though previous studies in other fields (e.g., Butts, 1993; Martin et al., 2013; Merikivi et al., 2016; Sansone et al., 1992) found positive connections between novelty satisfaction, effort and enjoyment, they did not clearly explain the mechanisms of novelty satisfaction. The present SDT-based study provides a clearer explanation of why novelty satisfaction leads to the positive outcomes of effort and enjoyment.

Based on previous research on novelty in PE (González-Cutre & Sicilia, 2019; González-Cutre et al., 2016), we examined the relationships among novelty satisfaction, satisfaction of three basic psychological needs, autonomous motivation, and outcomes such as effort and enjoyment in PE. The mediating mechanism of novelty satisfaction and outcomes was reconfirmed. Moreover, as shown in Figure 1, the needs for novelty, autonomy, competence, and relatedness are moderately to highly correlated, which suggests that the proposed need for novelty as a basic psychological need is supported in the present study, particularly in the context of distance PE amid the COVID-19 pandemic.

Limitations

Although this study revealed some key findings and provided evidence for the importance of novelty satisfaction in PE, its limitations should be addressed. First, the main limitation was the cross-sectional nature of the study and the sample size. Data collection is increasingly difficult due to the pandemic. Even with a solid theoretical foundation, we suggest that future studies adopt longitudinal or experimental designs and recruit more participants to produce more convincing results. Second, it should be acknowledged that the participants were all college students, and the context was during the COVID-19 pandemic, which limits the generalizability of the findings to other age groups and contexts. We suggest that future studies consider various age groups and contexts. Third, we focused on needs satisfaction, autonomous motivation, and positive outcomes in the present study, whereas needs frustration, controlled motivation, and negative outcomes were not included. By adding novelty frustration and examining its negative effects, such as displaying boredom or withdrawing effort, follow-up studies may improve our understanding of the role of the need for novelty in SDT. Finally, the present study confirmed the importance of novelty satisfaction in PE but did not develop strategies to support novelty satisfaction. As also suggested by [González-Cutre and Sicilia \(2019\)](#), it would be especially meaningful to develop novelty support strategies and examine their outcomes in future studies.

Conclusions

Recently, need for novelty was proposed as a candidate basic psychological need in SDT ([González-Cutre et al., 2020](#); [Vansteenkiste et al., 2020](#)). Following this new approach, the present study provided insights into needs satisfaction and the motivational underpinnings of effort and enjoyment in distance PE during the COVID-19 pandemic. Our findings highlighted the links among novelty satisfaction, satisfaction of three basic psychological needs, autonomous motivation, and outcomes such as effort and enjoyment in PE, and the results suggested the importance of novelty satisfaction in distance PE during the COVID-19 pandemic.

In conclusion, the current findings emphasize that it is crucial to satisfy students' needs for novelty, autonomy, competence, and relatedness. In particular, our findings suggested that students' effort and enjoyment can be elevated by satisfying their need for novelty and mediated by autonomous motivation in distance PE. Although we first examined the role that novelty satisfaction played in distance PE, the current literature and knowledge system do not specify how PE educators should satisfy students' need for novelty in distance learning. We urge future research to develop novelty-supportive strategies based on our findings. With no clear end of the current pandemic and a lack of knowledge about when a new pandemic will emerge, developing a set of effective strategies for novelty support will have major contributions to learning in PE.

Declaration of Conflicting Interests

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References

- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. <https://doi.org/10.1007/bf02723327>
- Banack, H. R., Sabiston, C. M., & Bloom, G. A. (2011). Coach autonomy support, basic need satisfaction, and intrinsic motivation of paralympic athletes. *Research Quarterly for Exercise and Sport*, 82(4), 722–730. <https://doi.org/10.1080/02701367.2011.10599809>
- Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Lang (eds.), *Testing structural equation models* (pp. 136–162). Sage.
- Butts, F. B. (1993). The impacts of on-location filming of a motion picture on tourists' level of enjoyment while attending a major coastal attraction. *Journal of Hospitality & Leisure Marketing*, 1(3), 31–39. https://doi.org/10.1300/j150v01n03_04
- Byrne, B. M. (2001). *Structural equation modeling with AMOS. Basic concepts, applications, and programming*. Lawrence Erlbaum Associates.
- Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1), 1–20. <https://doi.org/10.37074/jalt.2020.3.1.7>
- Crawford, S., & Fitzpatrick, P. (2015). The use of mobile digital technology and iPod touches in physical education. In Y. Zhang (ed.), *Handbook of mobile teaching and learning* (pp. 1–9). Springer.
- Curran, T., & Standage, M. (2017). Psychological needs and the quality of student engagement in physical education: Teachers as key facilitators. *Journal of Teaching in Physical Education*, 36(3), 262–276. <https://doi.org/10.1123/jtpe.2017-0065>
- Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. University of Rochester Press.
- Deci, E. L., Ryan, R. M., & Williams, G. C. (1996). Need satisfaction and the self-regulation of learning. *Learning and Individual Differences*, 8(3), 165–183. [https://doi.org/10.1016/s1041-6080\(96\)90013-8](https://doi.org/10.1016/s1041-6080(96)90013-8)

- Flores, M. A., & Gago, M. (2020). Teacher education in times of COVID-19 pandemic in Portugal: National, institutional and pedagogical responses. *Journal of Education for Teaching*, 46(1), 1–10. <https://doi.org/10.1080/02607476.2020.1799709>
- González-Cutre, D., Romero-Eliás, M., Jiménez-Loaisa, A., Beltrán-Carrillo, V. J., & Hagger, M. S. (2020). Testing the need for novelty as a candidate need in basic psychological needs theory. *Motivation and Emotion*, 44(2), 295–314. <https://doi.org/10.1007/s11031-019-09812-7>
- González-Cutre, D., & Sicilia, Á. (2019). The importance of novelty satisfaction for multiple positive outcomes in physical education. *European Physical Education Review*, 25(3), 859–875. <https://doi.org/10.1177/1356336x18783980>
- González-Cutre, D., Sicilia, Á., Sierra, A. C., Ferriz, R., & Hagger, M. S. (2016). Understanding the need for novelty from the perspective of self-determination theory. *Personality and Individual Differences*, 102, 159–169. <https://doi.org/10.1016/j.paid.2016.06.036>
- Hastie, P. A., De Ojeda, D. M., & Luquin, A. C. (2011). A review of research on sport education: 2004 To the present. *Physical Education & Sport Pedagogy*, 16(2), 103–132. <https://doi.org/10.1080/17408989.2010.535202>
- Hein, V., & Caune, A. (2014). Relationships between perceived teacher's autonomy support, effort and physical self-esteem. *Kinesiology*, 46(2), 218–226.
- Hellison, D. (2011). *Teaching responsibility through physical activity*. Human Kinetics Publishers.
- Hsu, W., Chou, H., & Pan, Y. (2014). A self-determination approach to the understanding of student responsibility behavior in physical education. *Physical Education Journal*, 47(3), 425–436. <https://doi.org/10.6222/pej.4703.201409.1008>
- Hsu, W., & Pan, Y. (2021). *Verification of reliability and validity of the Chinese version novelty satisfaction scale in physical education*. Manuscript submitted for publication.
- Hsu, W., Pan, Y., Shang, I., & Chou, C. (2021). *Students' efficacy profiles and outcomes of perceived relation-inferred self-efficacy support in physical education*. Manuscript Submitted for Publication.
- Hsu, W. T., Pan, Y. H., Chou, H. S., Lee, W. P., & Lu, F. J. H. (2014). Measuring students' responsibility in physical education instrument development and validation. *International Journal of Sport Psychology*, 45(5), 487–503. <https://doi.org/10.7352/IJSP.2014.45.487>
- Hung, S. W., & Chen, W. C. (2016). A study of integrating metacognitive strategy and Pad into physical education on the learning effectiveness of table tennis skills. *Journal of Taiwan Sport Pedagogy*, 11(2), 55-79. [http://dx.doi.org/10.6580%2fJTSP.2016.11\(2\).04](http://dx.doi.org/10.6580%2fJTSP.2016.11(2).04)
- Jackson, D. L., Gillaspay, J. A., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychological Methods*, 14(1), 6–23. <https://doi.org/10.1037/a0014694>
- Jeno, L. M., Vandvik, V., Eliassen, S., & Grytnes, J.-A. (2019). Testing the novelty effect of an m-learning tool on internalization and achievement: A self-determination theory approach. *Computers & Education*, 128, 398–413. <https://doi.org/10.1016/j.compedu.2018.10.008>
- Jöreskog, K. G., & Sörbom, D. A. G. (1989). *LISREL 7: A guide to the program and applications*. SPSS Inc.

- Liu, S. (2001). The application of distance instruction model in physical education. *Quarterly of Chinese Physical Education*, 15(1), 37-46. <https://doi.org/10.6223/qcpe.1501.200106.1805>.
- Lund, J., & Tannehill, D. (2014). *Standards-based physical education curriculum development*. Jones and Bartlett Publishers.
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7(1), 83–104. <https://doi.org/10.1037/1082-989x.7.1.83>
- Marsh, H. W., Hau, K.-T., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indices and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling: A Multidisciplinary Journal*, 11(3), 320–341. https://doi.org/10.1207/s15328007sem1103_2
- Marshall, R. J., & Mardia, K. V. (1985). Minimum norm quadratic estimation of components of spatial covariance. *Mathematical Geology*, 17(5), 517–525. <https://doi.org/10.1007/bf01032106>
- Martin, A. J., Nejad, H. G., Colmar, S., & Liem, G. A. D. (2013). Adaptability: How students' responses to uncertainty and novelty predict their academic and non-academic outcomes. *Journal of Educational Psychology*, 105(3), 728–746. <https://doi.org/10.1037/a0032794>
- Merikivi, J., Nguyen, D., & Tuunainen, V. K. (2016). Understanding perceived enjoyment in mobile game context. In Proceedings of the 2016 49th Hawaii International Conference on System Sciences (HICSS), Koloa, HI, USA, 5–8 January, 2016. IEEE.
- Pill, S., Hyndman, B., SueSee, B., & Williams, J. (2019). Physical education teachers' use of digital game design principles. *Journal of Teaching in Physical Education*, 40(1), 1–9. <https://doi.org/10.1123/jtpe.2019-0036>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40(3), 879–891. <https://doi.org/10.3758/brm.40.3.879>
- Rutten, C., Boen, F., Vissers, N., & Seghers, J. (2015). Changes in children's autonomous motivation toward physical education during transition from elementary to secondary school: A self-determination perspective. *Journal of Teaching in Physical Education*, 34(3), 442–460. <https://doi.org/10.1123/jtpe.2013-0228>
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.
- Sansone, C., Weir, C., Harpster, L., & Morgan, C. (1992). Once a boring task always a boring task? Interest as a self-regulatory mechanism. *Journal of Personality and Social Psychology*, 63(3), 379–390. <https://doi.org/10.1037/0022-3514.63.3.379>
- Sintema, E. J. (2020). Effect of COVID-19 on the performance of grade 12 students: Implications for STEM education. *Eurasia Journal of Mathematics, Science and Technology Education*, 16(7), 1851. <https://doi.org/10.29333/ejmste/7893>
- Sparks, C., Lonsdale, C., Dimmock, J., & Jackson, B. (2017). An intervention to improve teachers' interpersonally-involving instructional practices in high school physical education: Implications for student relatedness support and in-class experiences. *Journal of Sport & Exercise Psychology*, 39(2), 120–133. <https://doi.org/10.1123/jsep.2016-0198>

- Standage, M., Duda, J. L., & Ntoumanis, N. (2006). Students' motivational processes and their relationship to teacher ratings in school physical education: A self-determination theory approach. *Research Quarterly for Exercise and Sport*, 77(1), 100–110. <https://doi.org/10.1080/02701367.2006.10599336>
- Van Den Berghe, L., Vansteenkiste, M., Cardon, G., Kirk, D., & Haerens, L. (2014). Research on self-determination in physical education: Key findings and proposals for future research. *Physical Education and Sport Pedagogy*, 19(1), 97–121. <https://doi.org/10.1080/17408989.2012.732563>
- Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation & Emotion*, 44(1), 1–31. <https://doi.org/10.1007/s11031-019-09818-1>
- Varea, V., & González-Calvo, G. (2020). Touchless classes and absent bodies: Teaching physical education in times of Covid-19. *Sport . Education and Society*, 26(2), 1–15. <https://doi.org/10.1080/13573322.2020.1791814>
- Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology*, 112(7). <https://doi.org/10.1037/edu0000420>
- Vlachopoulos, S. P., Katartzi, E. S., & Kontou, M. G. (2011). The basic psychological needs in physical education scale. *Journal of Teaching in Physical Education*, 30(3), 263–280. <https://doi.org/10.1123/jtpe.30.3.263>
- Wallhead, T. L., Garn, A. C., & Vidoni, C. (2013). Sport education and social goals in physical education: Relationships with enjoyment, relatedness, and leisure-time physical activity. *Physical Education & Sport Pedagogy*, 18(4), 427–441. <https://doi.org/10.1080/17408989.2012.690377>
- Yli-Piipari, S., Wang, C. K. J., & Liukkonen, J. (2012). Examining the growth trajectories of physical education students' motivation, enjoyment, and physical activity: A person-oriented approach. *Journal of Applied Sport Psychology*, 24(4), 401–417. <https://doi.org/10.1080/10413200.2012.67709>
- Zhang, T. (2009). Relations among school students' self-determined motivation perceived enjoyment, effort, and physical activity behaviors. *Perceptual and Motor Skills*, 109(3), 783–790. <https://doi.org/10.2466/pms.109.3.783-790>