Validating the Constructivist Instructional Practices Scale for Cambodian High School Teachers Context: Exploratory and Confirmatory Factor Analysis

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ABSTRACT

Purpose of the study: This study aimed to develop and validate the constructivist instructional practices scale, grounded in constructivist learning theory, concentrated on three dimensions: teacher's autonomy support, teacher's support and feedback, and cooperative learning support.

Methodology: 626 participants from 9 high schools across 4 provinces in Cambodia were selected conveniently. The data was analyzed by using an exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Main Findings: The initial 18-item instrument was refined to a 15-item scale after removing three items with weak, cross, or negative loadings. The final model confirmed a three-factor structure: Teacher Autonomy Support (TAS), Teacher Support and Feedback (TSF), and Cooperative Learning (CL). The instrument demonstrated high internal consistency (Cronbach's alpha > 0.80) and robust factorial validity (CFI > 0.95, RMSEA < 0.06), proving to be a reliable tool for measuring student-centered teaching behaviors.

Novelty/Originality of this study: This research fills a critical gap by providing the first psychometrically validated scale for constructivist practices tailored to the Cambodian high school context. It contributes to educational assessment by offering a reliable framework for evaluating the shift toward student-centered pedagogy in Southeast Asian classrooms.

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1. INTRODUCTION

Constructivist instructional practices referred to teaching approaches that emphasized active student engagement, collaborative learning, and instruction facilitation above direct instruction. Rooted in constructivist theory, onstructivist instructional practices encouraged student to construct their own understanding though exploration, reflection, and social interaction [1]-[4]. From perspective of self-determination theory, these practices aligned with the fulfillment of students' basic psychological needs (needs for autonomy, needs for competence, and needs for relatedness) thereby boosting their intrinsic motivation and learning outcome [5], [6]. According to self-determination theory, students learnt more when their psychological needs were satisfied. It meant that teaching autonomy support provided students with choices in learning and encouraging self-directed learning that enhanced their sense of ownership; structure which included clear expectations and constructive feedback, fostered competence by helping students developed their mastery experiences; finally, involvement (such as cooperative learning and teacher-student rapport) fulfilled the needs for relatedness by creating supportive and connected learning environment [7], [8].

Previous studies consistently demonstrated that teachers who adopted these practices positively influenced students' engagement, achievement, and well-being [9], [10]. Despite the well-established benefits of CIP, there remains a need for reliable and valid instruments to measure these practices, particularly in high school environments. Existing instruments often concentrated on general teaching behaviors rather than specific constructivist dimensions that aligned with self-determination theory. To address this gap, the present study aims to develop and validate an instrument assessing three key dimensions of constructivist instructional practices: (1) teachers' autonomy support which promotes student agency in learning; (2) teachers' support and feedback, which enhance students' competence though structured guidance; and (3) cooperative learning support which fosters relatedness through peer collaboration. By providing a psychometrically sound measure, this study will contribute to research and practice that enable high school teachers to be better assess and refine their instructional approaches in aligning the constructivist and SDT principles.

Previous research has explored constructivist teaching or constructivist pedagogy and proposed various measurement tools [11]-[13], these efforts have often been conducted in different educational levels or cultural contexts and have rarely provided comprehensive evidence of both reliability and validity within high school settings. Moreover, earlier studies have tended to focus either on specific dimensions of constructivist practice or on limited aspects of instrument validation, without simultaneously evaluating the factorial structure and psychometric properties of a unified scale. Given the limited availability of rigorously validated instruments tailored to high school contexts, this study sought to establish and test a multidimensional measure grounded in constructivist theory. While empirical investigations in this specific context remain relatively scare, the findings largely align with prior theoretical and empirical work on constructivist pedagogy.

Constructivist Instructional Practices prioritize active student engagement and collaborative learning. Grounded in Self-Determination Theory, these practices fulfill students' psychological needs for autonomy, competence, and relatedness. Despite the benefits of constructivist instructional practices, most existing measurement tools are developed for Western contexts and lack rigorous validation in Southeast Asia. The urgency of this research stems from Cambodia's educational reforms, which require valid metrics to assess the implementation of student-centered learning. This study provides a culturally appropriate tool, the CIPS, to address this gap.

Most current constructivist pedagogy or constructivist teaching have been developed and test in Western or non-Cambodian setting. This work significantly contributes by establishing and validating a culturally appropriate CIP scale, which has not been previously accomplished for Cambodia. The current research has two primary objectives:

1) To examine the validation of the initial instruments of constructivist instructional practices within the Cambodian setting through exploratory factor analysis (EFA).
2) To examine the convergent and discriminant validity of the constructivist instructional practices scales subsequent to its validation and refinement through confirmatory factor analysis (CFA).

2. LITERATURE REVIEW

2.1. Overview of Constructivist Instructional Practices

Constructivist instructional strategies grounded in the fundamental theories that posited knowledge as an active construction rather than a passive acquisition, drawing from cognitive and social perspectives to inform instructional design in high school classrooms. Central to this framework was Jean Piaget's cognitive constructivism which Piaget [1] emphasized learners' developmental stages and the assimilation of new information into existing schemas through interaction with the environment, thereby promoting disequilibrium and resolution via hand-on exploration. Complementing this stabilities, Leo Vygosky's social constructivism [3] highlighted the zone of proximal development where scaffolding through social interactions enables learners to achieve beyond independent capabilities, underscoring the role of collaborative dialogues in knowledge co-construction, John Devy [14] further advanced experimental learning, advocating for problem-solving which rooted in the real world contexts to foster democratic participation and reflective thinking while Jerome Bruner's discovery learning model [15] encouraged spiral curricula that revisit concepts at increasing complexity to build on prior knowledge. These theories converge on principles such as learner-centered approaches where teachers facilitate rather than direct, integrating multiple perspective, metacognition, and authentic tasks to support meaning-making that tailored to adolescents' diverse cultural and experiential backgrounds. In high school settings, such strategies manifest in inquiry-based activities and peer negotiations that align with radical constructivism's view of subjunctive reality construction, ensuring instructional practices adapt to students' evolving autonomy and social need.

Constructivist Instructional Practices emphasized student centered approaches that foster autonomy, collaborative and active knowledge construction. Grounded in the belief that learners can build meaningfulness through the interaction with the content, with peer, and with contextual experiences, CIP closely aligned with SDT [5], [16]. SDT posited that optimal motivation and learning occurred when three basic psychological needs are satisfied[5]. It referred to autonomy, competence, and relatedness [6], [17]. Empirical evidence supports of the application of teacher autonomy support, teacher feedback and support, and cooperative learning. Within this framework, that studies suggested that instructional nurturing these needs enhanced student engagement and intrinsic motivation [18]-[20].

In classroom, instructional strategies that deserved students' abilities were investigated gradually. The present research results indicated that teacher's support for these needs significantly impacts on students' motivation. Autonomy support involved enabling students to make choices and took ownerships of their learning processes which has been linked to higher intrinsic motivation and persistence of them [18], [20]. Referring to as teacher structure, structure feedback and clear explanations, bolstered perceptions of competence that can foster students' confidence and mastery [9], [21]. Additionally, fostering relatedness through social interaction and collaboration can increase students' feelings of belongingness and motivation [5], [22]. Despite robust theoretical support, there were notable gap in measurement tools that integrated these dimensions within high school context comprehensively.

2.2. Empirical Research Related to Constructivist Instructional Practices

Empirical investigations that related to constructivist instructional practices revealed their efficacy in enhancing student engagement, motivation, and achievement, particularly, in high school contexts where traditional methods often apply to diverse learners' need. Arega and Hunde [23] identified seven broad constructivist approaches such as inquiry -based learning, problem-based learning, and collaborative projects implemented across K12 setting with metanalytic evidence which this study indicated moderate to large effects on cognitive outcomes (e.g., deeper conceptual understanding) and effects gains (e.g., intrinsic motivation). Though high school -specific applications showed variability due to curricular constraints.

In science education, Gangwar [24] showed secondary school teachers who employed constructivist practices reported higher student efficacy and reform-aligned instruction, as measured by surveyed linking these strategies to improve problem-solving and reduce achievement gaps. With longitudinal data from around 200 educators. The results confirmed that sustained implementation challenges like time demands but affirming benefits for at risk learners. Further research in Ethiopian middle and high school Tsehay, et al. [25] highlighted that barriers such as resource scarcity and teacher training gaps, yet the qualitative analysis from 150 social studies teachers demonstrated that constructivist facilitation of student-led discussions boosted critical thinking and equity, with pre and post assessment which yielding effects size of 0.45 to 0.72.

These studies collectively underscored the need for context-sensitive adaptations. It means that as constructivist environments not only elevated learning strategies but also mitigated disengagement in adolescent populations through empirical gaps persist in non-Western high school validation [23], [24], [26]. Empirical Multiple studies substantiated of CIP under the self-determination theory which demonstrated that teachers' autonomy support, teacher support and feedback and cooperative learning collectively fostered motivation and academic achievement across educational level [27], [28]. The study by Chan, et al. [28] revealed that autonomy support increased intrinsic motivation, competence, and relatedness among student in an EFL classroom.

2.3. The Original Construction and Development of Instruments That relating to Measuring Constructivist Instructional Practices

The evolution of instrument for assessing constructivist instructional practices has progressed from observational protocols to self-reported scales which iteratively refined to capture student-centered elements in high school teaching. The classroom constructivism inventory that Samuels [29] developed evaluate active knowledge construction in P-12 setting, comprised 24 items across four subscales: (1) student-centered activities contained 6 items), (2) democracy contained 6 items, (3) professionalism contained 6 items, and (4) inquiry skills contained 6 items. These items rated on a 5-Lierk scale that drawing from Piagetian and Vygoskian principles as well as Bybee's five Es model. Validation with 48 high school teachers demonstrated that subscale reliabilities of 0.79 to 0.83 (Cronbach's alpha) and test -retest correlations of 0.53 to 0.70, with confirmatory t-test ($p < 0.015$) distinguishing trained constructivist practitioners from traditional ones, affirming its unity for real time classroom differentiation applicable to adolescent inquiry.

Similarly, the scale for constructivist learning environment management skills was crafted by Yildirim [30] for elementary and high school teachers which starting with a 47 items that informed by literature review and expert interviews, refined to 33 items across six factors: (1) communication and interaction contained 5 items, (2) time usage and assessment contained 6 items, (3) learning and teaching contained 6 items, and (4) learning environment organization contained 5 items. Exploratory and confirmatory factor analyzed on 633 Turkish educators yielded strong fit (RMSEA = 0.039, CFI = 0.95 and reliabilities (0.65 to 0.88 subscales, 0.95

total), with test-retest at -.93, positioning it as a robust tool for evaluating management skills in constructivist high school environments.

Meanwhile Backes, et al. [31] also explored on the constructivist teaching practices inventory in elementary physical education which adapted for Brazilian pre-service teachers, retained 18 items in three factors: (1) Personal relevance contained 5 items, and social cooperation contained 8 items. After Bayesian analyses on 869 participants, the Cronbach's alpha was 0.86 to 0.94 and feasible given its focus on adolescent-relevant collaboration. In conclusion, these instruments have undergone successive refinements. It was from multifactor observational tool with 25 to 36 items to parsimonious 18 to 33 item scales which validated via factor analyses and expert reviews, ye high school-specific empirical refinement in diverse cultural contexts remain sparse.

2.4. Teacher Autonomy Support in Constructivist Instructional Practices

Teacher autonomy support emerges as a cornerstone of constructivist practices that embodying a student-focused interpersonal tone that nurtured volition and self-endorsement thereby aligning with Vygoskian scaffolding and Deweyian experimentalism in high school instruction. Defined within self-determination theory, Ryan and Deci [16] stressed that autonomy support behavior as providing choices, explanatory rationales, and invitational language that enabled students to internalize learning goals, fostering intrinsic motivation and engagement through perceptive-taking and need satisfaction. Teachers' autonomy support: Teachers provided meaningful alternatives tolerated errors and respect students' perspectives that contributed to a sense of ownership and motivation [6], [16]. Empirical studies in various educational settings confirmed that the position of effects of autonomy support on motivation and academic achievement [18].

However, the operationalization of these behaviors remained limited across diverse contexts, especially, in high school setting. Empirical interventions across 38 randomized trials demonstrated its malleability with 95% yielding large effect increased in student autonomy (e.g., via training phases emphasizing dialogue and patience), linked to enhanced academic achievement, prosocial behaviors, and reduced disaffection in adolescent cohorts [32]. In blended models, autonomy support integrated with structure provisions to balance freedom and guidance, as cognitive autonomy behaviors (e.g., choice in task engagement) predicted deeper conceptual learning in high school science, with path analysis showed mediated effects on resilience ($\beta = 0.32$, $p < 0.01$) [33]. This support mitigated cultural stressors in observations, promoting harmonious constructivist environments where teachers' endorsements of student initiative enhance equity and long-term motivation [34].

2.5. Teachers' Support and Feedback in Constructivist Instructional Practices

Teachers' support and feedback constituted vital mechanisms in constructivist practices that facilitated reflecting knowledge construction through formative interactions that bridged prior schemas to new understandings in high school settings. Teachers' support and feedback: Structured feedback aligned with SDTs' competency component which supported mastery and self-efficacy [16]. Previous research demonstrated that supportive feedback can enhance learners' confident, feedback literacy and psychological well-being [6], [9]. Nonetheless, few instruments currently measure teachers' feedback practices within the constructivist and self-determination theory paradigms simultaneously [35].

Grounded in social constructivism, effective feedback adopted a dialogue tone which enabled learners to negotiate meaning and refine metacognition, as evidenced in models where teachers scaffolding via rationales and peer reviews boosted performance by 20% to 30 % in problem-based tasks [36]. Constructivist-orientated teachers, holding beliefs in active inquiry, perceive observations and feedback as valuable growth opportunities, positively correlating with reduced psychosocial stress ($r = -.28$) and sustained participation intentions ($\beta = .41$), particularly in collectivist cultures where harmonious support aligned with relational norms [37]. Instructional scaffolds for feedback literacy further empower both teachers and students, with staged models (e.g., processing comments via rubric and self- assessments) yielding improved uptake and application, as pre and post data from 200 high school educators Kleijn [38] showed gains in student agency ($d = 0.56$). These elements ensured feedback transcends evaluative roles which embedded support within democratic classroom cultures to foster equitable achievement [39].

As above review, while the convergence of constructivist instructional practices under self-determination theory is well-documented, most measurement tools treated these constructs individually or within narrow domains, limiting their utility for comprehensive assessment in high school setting (Williams, 2017). Given the importance of these dimensions in promoting motivation and learning, there is a critical need for validated instruments that capture teachers' support for autonomy, structured feedback, and cooperative learning simultaneously form self-determination theory perspective. This review underscores the importance of developing such a tool that operationalizes these core dimensions within constructivist instructional practices that enable teachers and researchers to be better understand and enhance instructional quality student motivation during and after class.

3. RESEARCH METHODS

3.1. Research Design

This study employed a quantitative research design aimed at developing and validating an instrument measuring high school teachers' support for constructivist instructional practices. The process involved scale development, exploratory factor analysis ((EFA), Confirmatory factor analysis (CFA), and assessing of reliability and validity to ensure the instrument's robustness and applicability with instructional practices.

3.2. Participants

The sample comprised approximately 626 high school teachers drawn from four provinces and one capital city across the country. Participants were selected through convenience sampling from nine public high schools. These four provinces were selected because they represent the four regions of the country: the eastern region, the western region, the southern region, and the northern region. Of the nine public high schools, one high school was located in the capital city, and two high schools were selected from each region.

The mean age of participants was 25.34 years (SD=2.12). The sampling consisted of 348 (55.6%) female teachers. They have been taught between grade 10 to grade 12. Their subject areas: Mathematics, Science, Social Science, and Languages, and their teaching experiences between two to thirty-two years. Eligibility criteria included at least two years of teaching experiences to ensure familiarity with constructivist instructional practices. The average time used in filing the questionnaire was about 13 minutes.

3.3. Instrument Development Procedure

In this study, Items were initially drafted which based on an extensive literature review of constructivist instructional practices, SDT, and related validated scales. Each of three dimensions (teachers' autonomy support, teachers' feedback and support, and cooperative learning support) represented by 6 items. A panel for three education experts reviewed the items for content relevance, clarity, and comprehensiveness. The three experts are two curriculum and instruction researchers and a learning innovation and technology researcher. Based on their feedback, items were revised or eliminated to improve clarity and content validity. There was not any item was removed by expert suggestion. Next, the refined instrument which consisted of approximately 18 items, were conducted a back-translation of items by two researchers who were qualified in both languages: Khmer and English. Finally, the items were pilot-tested with 33 teachers in one high school. The teachers evaluated the clarity of these items on a scale ranging from 1 (very unclear) to 5 (very clear). Only three items were rated neutral in clarity, mostly rated in high clarity. Therefore, we removed the items (e.g. I make an ease for my students to take what I gave them feedback to them by recording it in their notebook for improving their work." in teachers' supportive and feedback subscale). The mean clarity score of the 18-items was 4.21 (SD=0.23). The mean of clarity scores for each item was released in Table 1. Item analysis involved calculating item-total correlations, ensuring each item correlated significantly with its respective subscale ($r > 0.30$). Items with low correlations were removed. Internal consistency reliability was evaluated by using Cronbach's Alpha which sought values above 0.70.

Following pilot testing and refinement, the finalized questionnaire was distributed both electronically via Google Form and hard copy by researchers. The research placed strong emphasis on protecting participants' privacy, ensuring anonymity and confidentiality. This approach was intended to minimize and potential psychological discomfort, stress, or harm to participants. Participation was completely voluntary and conducted under secure condition. To support informed decision-making, participant received clear and detailed explanations about the study goals and procedures. Before data collection began in the high schools, The researcher also sought formal approved from relevant Cambodia educational authorities. Authorization was successfully obtained from (a) the Ministry of Education, Youth, and Sport, (b) the head of the Provincial Offices of Education, Youth, and Sport, (c) The principals of the 36 participating school, (d) the teachers across the six sampled regions. Data collection occurred over three months.

Table 1. Item and Item Source of Constructivist Instructional Practices

N_0.	Item	Sources
	Teacher autonomy support	
1	I encourage students to share their personal experiences and knowledge to support group learning.	(Cabrera, Colbeck, & Terenzini, 2001)
2	I allow students to participate in decision-making about what they should learn.	(Lam, Pak, & Ma, 2007)
3	I allow students to choose what to learn or work in groups.	(McRobbie & Tobin, 1997)
4	I allow students to choose homework assignments or research tasks based on their interests.	(Lam, Pak, & Ma, 2007)
5	I provide a variety of research tasks so that students can choose any one of	(McRobbie & Tobin,

	them.	1997)
6	I take students' opinions into account when designing research tasks for them.	(Lam, Pak, & Ma, 2007)
	Teacher support and feedback	
7	I create a classroom environment where students feel confident expressing their ideas and asking questions.	(Feldman, 1976)
8	I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.	(Cabrera, Colbeck, & Terenzini, 2001)
9	I check whether students understand the lesson before moving on to the next part.	(Feldman, 1976)
10	I provide constructive feedback that have improve students' understanding of the lesson.	(Heng, 2014)
11	I give useful feedback on students' homework or research assignments.	(Toland & Ayala, 2005)
12	I provide constructive feedback that helps enhance students overall learning.	(Cabrera, Colbeck, & Terenzini, 2001)
	Support for cooperative learning	
13	I create opportunities for students to discuss idea with one another in groups.	(Kuh, 2009)
14	I encourage students to try to understand the ideas of other students in their group.	(McRobbie & Tobin, 1997)
15	I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.	(Cabrera, Colbeck, & 5Terenzini, 2001)
16	I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.	(Kuh, 2009)
17	I encourage students to collaborate with group members in preparing group-based research assignments.	(McRobbie & Tobin, 1997)
18	I encourage students to take shared responsibility for the outcomes of group work.	(Cabrera, Colbeck, & Terenzini, 2001)

3.4. Data Analysis

Descriptive Statistics: Computed means, standard deviations, and frequency distributions for each item and subscale to examine response tendencies and distribution normality.

Exploratory Factor Analysis (EFA) was commonly applied in initial phases of scale development to determine whether questionnaire items corresponded to the constructs they were intended to measure. Its purpose was to uncover the underlying factor structure of constructivist instructional practice which based on the core items included in the instrument. In this study, the analysis was performed using exploratory factor analysis (EFA), employing the principal axis factoring method with Oblimin rotation correlated factors with eigenvalue greater 1.0. Following extraction, each preliminary dimension of constructivist instructional practices was reexamined to ensure that the conceptual meaning aligned with the items that loaded onto it. Two main criteria were used to evaluated the sustainability items for each factor: standardized factor loadings and internal consistency reliability. Loadings of 0.50 or higher were considered acceptable [40], and Cronbach's alpha values of at least 0.70 indicated adequate reliability [41]. Items that did not load onto their expected factors may be revised or removed during the instrument refinement stage [42]. Although EFA did not provide final validation, it was an important diagnostic tool that helped determine whether the proposed constructs were meaningful and whether the scale demonstrated preliminary construct validity [43]. EFA also contributed to improve the clarity and reliability of the scale by highlighting which item should be kept, modified, or excluded [44]. In this study, EDA was used specifically to examine how effectively the items within each variable clustered together.

After completing the EFA, Confirmatory Factor Analysis (CFA) was conducted to further validate the constructivist instructional practices scale which focused on both convergent and discriminant validity. Convergent validity was evaluated using three indicators: (a) standardized factor loading, (b) construct reliability, and (c) average variance extracted (AVE) [40]. Discriminant validity was assessed by comparing the square root of each construct's AVE with its correlations with other constructs in the model [45]. CFA was performed using Mplus version 7.11. Standardized factor loadings represented the strength of the relationship between each observed variable and its underlying factor. AVE captures the extent to which the items of a latent construct share common variance, expressed as the average proportion of variance explained [40]. The commonly accepted thresholds were: factor loadings ≥ 0.50, AVE ≥ 0.50, and CR ≥ 0.70, as recommendation by Hair, et al. [40]. Model fit was examined using multiple fit indices, which included Chi-Square (with recommended ratio $3.0 \leq x^2/df \leq 5.0$), the comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardized

Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) [40], [46]. For models involving than 250 participants and 30 or more observed variables, acceptable fit was generally characterized by significant Chi-Square values, CFI and TLI values above0.92, SRMR ≤ 0.08, and RMSEA < 0.07 when CFI ≥ 0.92 [40]. According to Kline [46] RMSEA values below 0.05 indicated excellent model fit, while values below 0.08 reflect an acceptable fit.

4. RESULTS AND DISCUSSION

4.1. Findings

4.1.1. Validating Tool of Constructivist Instructional Practices

The instrument was reviewed and endorsed by a panel of three experts from the Ministry of Education, Youth, and Sport. All panel members hold doctor degrees and have extensive experience in university level teaching and research. They confirmed the survey items use in this study appropriately represented the construct of constructivist instructional practices. Revisions to the instrument were subsequently made in response to their recommendations. Following expert validation, a polit field teat of the instrument as presented in Table 2, was carried out. Thirty-three teachers who participated in the plot study were invited to provide feedback on various aspects of the questionnaire, including its length, clarity relevance of items, and any additional impressions. The researchers incorporated this feedback to further refine the instrument prior to the main data collection. No issue or concerns were reported by the teachers by teachers involved in the pilot testing.

Table 2. CIP Scale Developed Through Feedback From a Panel Expert

No	Item	TAS	TSF	CL
1	I encourage students to share their personal experiences and knowledge to support group learning.	x		
2	I allow students to participate in decision-making about what they should learn.	x		
3	I allow students to choose what to learn or work in groups.	x		
4	I allow students to choose homework assignments or research tasks based on their interests.	x		
5	I provide a variety of research tasks so that students can choose any one of them.	x		
6	I take students' opinions into account when designing research tasks for them.	x		
7	I create a classroom environment where students feel confident expressing their ideas and asking questions.		x	
8	I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.		x	
9	I check whether students understand the lesson before moving on to the next part.		x	
10	I provide constructive feedback that have improve students' understanding of the lesson.		x	
11	I give useful feedback on students' homework or research assignments.		x	
12	I provide constructive feedback that helps enhance students overall learning.		x	
13	I create opportunities for students to discuss idea with one another in groups.			x
14	I encourage students to try to understand the ideas of other students in their group.			x
15	I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.			x
16	I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.			x
17	I encourage students to collaborate with group members in preparing group-based research assignments.			x
18	I encourage students to take shared responsibility for the outcomes of group work.			x

TAS = Teacher autonomy support; TSF = Teacher's support and feedback; CL = Cooperative learning support

The following field test was the result from 39 secondary school teachers in 11 provinces of Cambodia filled in the updated CIP tools which showed in Table 3.

4.1.2. The Results of Exploratory Factor Analysis For Constructivist Instructional Practices

Following the pilot field test, the revised constructivist instructional practices (see Table 3) was administered to teachers from 39 high schools across 11 provinces in Cambodia. These schools were selected to represent diverse geographical and educational contexts, ensuring that the collected data reflected a broad range of teaching experiences within the national education system. Teachers responded to each item using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), covering the 18 proposed constructs of constructivist instructional practices. The collect responses were analyzed using principal axis factoring with Varimax rotation in order to explore the underlying relationships among the items and to identify correlation latent factors. This analytical approach was selected because it allowed for intercorrelations among factors which was theoretically appropriate for constructivist instructional practices constructs. The analysis revealed three key findings regarding the structure of the instrument. The rotation factor solution which included the standardized factor loadings for each item, was presented in Table 3. These results provided empirical support for the underlying dimensions of constructivist instructional practices and offered evidence of the instrument's construct validity within the Cambodian high school context.

Table 3. Item-Level Analysis of High School Teachers' Responses to CIP

	Items	Mean	SD	Skewness	Kurtosis	Corrected Item-total correlation
	Teacher autonomy support					
TAS1	I encourage students to share their personal experiences and knowledge to support group learning.	3.58	0.79	0.37	-0.51	-0.02
TAS2	I allow students to participate in decision-making about what they should learn.	3.63	0.81	0.50	-0.86	0.61
TAS3	I allow students to choose what to learn or work in groups.	3.58	0.80	0.34	-0.61	0.54
TAS4	I allow students to choose homework assignments or research tasks based on their interests.	3.52	0.75	0.61	-0.39	0.60
TAS5	I provide a variety of research tasks so that students can choose any one of them.	3.69	0.70	0.33	-0.65	0.46
TAS6	I take students' opinions into account when designing research tasks for them.	4.09	0.75	-0.30	-0.71	0.47
	Teacher support and feedback					
TSF1	I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.	4.46	0.61	-0.67	-0.51	0.42
TSF2	I check whether students understand the lesson before moving on to the next part.	4.35	0.60	-0.34	-0.67	0.46
TSF3	I create a classroom environment where students feel confident expressing their ideas and asking questions.	3.52	0.50	-0.08	-2.00	0.01
TSF4	I provide constructive feedback that have improve students' understanding of the lesson.	4.28	0.61	-0.23	-0.60	0.39
TSF5	I give useful feedback on students' homework or research assignments.	4.18	0.50	0.30	0.30	0.56
TSF6	I provide constructive feedback that helps enhance students overall learning.	4.39	0.53	0.01	-1.07	0.39
	Cooperative learning supprot					
CL1	I create opportunities for students to discuss idea with one another in groups.	3.93	0.56	-0.03	0.20	0.26
CL2	I encourage students to try to understand the ideas of other students in their group.	3.86	0.79	-0.44	0.00	0.31
CL3	I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.	3.81	0.57	-0.08	-0.05	0.32
CL4	I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.	3.73	0.62	-0.41	0.37	0.35
CL5	I encourage students to collaborate with group members in preparing group-based research assignments.	3.87	0.79	-0.58	0.20	0.30
CL6	I encourage students to take shared responsibility for the outcomes of group work.	2.23	0.44	1.61	1.44	-0.03

Table 3 indicated the results of the item-level analyses. The internal consistency of overall scale (r = 82) and the three subscales (r > 0.84) was high.

Item-level Skewness values fell between -0.67 and 1.61, while Kurtosis values ranged from -2.00 to 1.44. These indicated that the responses for each item did not meaningfully depart from a normal distribution [46]. Furthermore, correlated item-total correlations varied from -0.03 to 0.56. All values met or exceeded the conventional threshold of 0.15 [47], confirming that every item aligned well with the overall construct measured by the scale [43].

Table 4. Rotated Component Matrix For CIP

	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
TAS1	I encourage students to share their personal experiences and knowledge to support group learning.				0.97	
TAS2	I allow students to participate in decision-making about what they should learn.		0.84			
TAS3	I allow students to choose what to learn or work in groups.		0.75			
TAS4	I allow students to choose homework assignments or research tasks based on their interests.		0.81			
TAS5	I provide a variety of research tasks so that students can choose any one of them.		0.77			
TAS6	I take students' opinions into account when designing research tasks for them.		0.76			
TSF1	I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.			0.80		
TSF2	I check whether students understand the lesson before moving on to the next part.			0.80		
TSF3	I create a classroom environment where students feel confident expressing their ideas and asking questions.					-0.62
TSF4	I provide constructive feedback that have improve students' understanding of the lesson.			0.74		
TSF5	I give useful feedback on students' homework or research assignments.			0.71		
TSF6	I provide constructive feedback that helps enhance students overall learning.			0.72		
CL1	I create opportunities for students to discuss idea with one another in groups.	0.83				
CL2	I encourage students to try to understand the ideas of other students in their group.	0.81				
CL3	I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.	0.85				
CL4	I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.	0.86				
CL5	I encourage students to collaborate with group members in preparing group-based research assignments.	0.79				
CL6	I encourage students to take shared responsibility for the outcomes of group work.					0.79

The suitability of the data for analysis was confirmed by Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of .873 and statistically significant Bartlett's Test Sphericity, X^2 (153, N = 626) = 4753.28, P < .001. These results indicated that the correlation matrix was appropriate for factor extraction. As shown in Table 4, the initial exploratory factor analysis identified four underlying factors among the constructivist instructional practices items. These five factors, with eigenvalues of 4.81, 3.46, 1.67, 1.04, and 1.01, together accounted for 66.64% of the total variance in the instrument.

Although three items (TAS1, TSF3, and CL6), which were designed to measure teachers' perceptions of the task analysis dimension, failed to load as expected. Instead, these items loaded strongly out of the three group competence factors: TAS1 showed strong loading (0.97 in factor 4), TSF3 showed negatively strong loading (-0.67 in factor 5, and CL6 showed strong loading (0.79 in factor 5). Given their insufficient associate with the intended constructs were considered for removal. This decision aligned with the recommendation of Hair, et al. [40], Tabachnick and Fidell [48] to exclude items with low factor loading due to its limited contribution to construct validity or out of the group.

4.1.3. Item Deletion for CIP and the Scree Plot Showing

Table 5. Rotated Component Matrix For CIP

ITEM	Factor 1	Factor 2	Factor 3
TAS2		0.84	
TAS3		0.75	
TAS4		0.81	
TAS5		0.77	
TAS6		0.76	
TSF1			0.80
TSF2			0.80
TSF4			0.74
TSF5			0.71
TSF6			0.72
CL1	0.83		
CL2	0.81		
CL3	0.85		
CL4	0.86		
CL5	0.79		

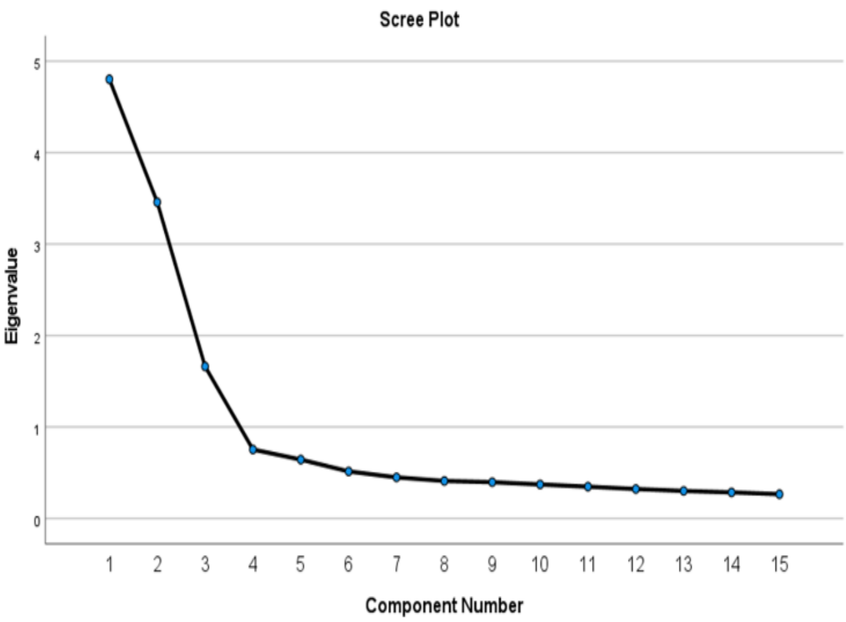


Figure 1. Scree Plot of Constructivist Instructional Practices

The results of the exploratory factor analysis provided in Table 5 indicate that three items (TAS1, TSF3, and CL6) did not meet the recommended criteria for retention and were therefore removed from the scale. Item TAS1 showed too strong and defuse loadings to another factors. Item TSF3 exhibited a negative loading on a factor that was theoretically inconsistent with its intended construct which indicated poor conceptual alignment, reflecting an inverse relationship with the underlying factor and raising concerns regarding item validity. Item CL6 demonstrated a strong loading (0.79), and defuse loadings to another factors. According to established guidelines, items with low, too high, Cross, or negative factor loadings should be excluded to improve construct clarity and measurement quality [40], [46]. Following the removal of these three items, the remaining 15 items displayed satisfactory factor loading and a more coherent factor structure, supporting the adequacy of the refined measurement model for subsequent confirmatory factor analysis.

4.1.4 Confirmatory Factor Analysis

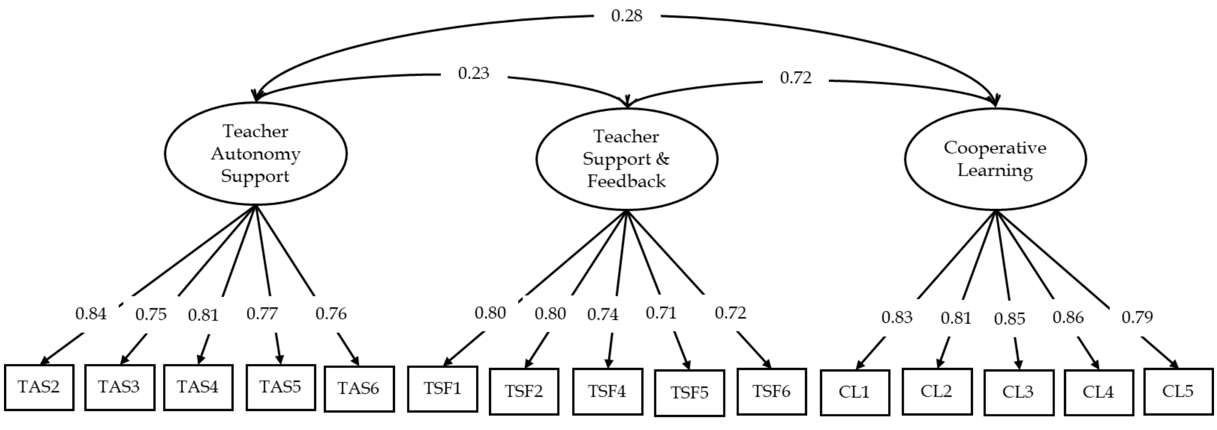
Table 6. The Factor Loading of Constructivist Instructional Practices (CIP)

Latent Variables	Indicators	Estimate	S.E.	Est./S.E.	Two-Tailed *P*-value
	TAS2	0.857	0.014	61.34	< .001
	TAS3	0.772	0.019	41.15	< .001
TAS	TAS4	0.841	0.015	56.63	< .001
	TAS5	0.647	0.026	25.24	< .001
	TAS6	0.680	0.024	28.42	< .001
	TSF1	0.661	0.027	24.71	< .001
	TSF2	0.786	0.021	36.92	< .001
TSF	TSF4	0.698	0.025	27.79	< .001
	TSF5	0.807	0.021	38.88	< .001
	TSF6	0.564	0.031	18.05	< .001
	CL1	0.770	0.019	39.76	< .001
	CL2	0.748	0.021	36.35	< .001
CL	CL3	0.820	0.017	49.60	< .001
	CL4	0.842	0.015	54.89	< .001
	CL5	0.729	0.022	33.87	< .001

The latent construct of CIP was assessed using three subscales that each subscale contained 5 observed indicators. Each indicator robust and highly statistically significant factor loadings (all $P < 0.001$). The Est/S.E. ratios for all loadings substantially exceed the conventional threshold for significance (typically > 2.0), providing strong evidence that these items served as dependable measures of the underlying construct. Moreover, all standardized loadings surpass the commonly accepted minimum threshold of 0.50 in the research literature [40]. The factor loadings ranged from 0.75 to 0.84 for TAS, from 0.71 to 0.80 for TSF, and from 0.79 to 0.86 for CL that reflected generally strong associations between the indicators and CIP construct, through with some modest differences in the magnitude of their constructs. All indicators display relatively stronger contributions. Overall, The CIP latent variable was effectively captured by its three subscales (TAS, TSF, and CL), each subscale demonstrated statistically significant and substantively meaningful loadings.

Table 7. Factor Loading, Residual Variances, CR, AVE/Square Root, MSV, ASV

Variable	Estimate				
	Factor loading	CR	AVE/Square root	MSV	ASV
Teacher autonomy support	0.75-0.86	0.87	0.58 / 0.76	0.73	0.055
Teacher support and feedback	0.70-0.79	0.82	0.50 / 0.71	0.65	0.010
Cooperative learning	0.79-0.86	0.89	0.61 / 0.78	0.71	0.003



Notte: All factorr loadingg are signifficant at P < 0.001

Figure 2. Factor Structure of the Constructivist Instructional Practices

Table 7 showed the goodness-of-fit indices for the measurement instruments used in the model. The confirmatory factor analysis (CFA) indicated that all constructs demonstrated satisfactory validity. The standardized factor loadings ranged from 0.70 to 0.86. Composite reliability (CR) values were 0.87 for teacher autonomy support, 0.82 for teacher support and feedback, and 0.89 for cooperative learning, with the corresponding average variance extracted (AVE) values of 0.58, 0.50, and 0.61 respectively. These results suggested adequate convergent validity, consistent with the criteria proposed by Hair, et al. [40]. The maximum shared variance (MSV) ranged from 0.65 to 0.73, and the average shared variance (ASV) ranged from 0.003 to 0.055; both were lower than their respective AVE values. In addition, the square root of the AVE for each construct exceeded 0.50 and was greater than its correlations with other constructs. These finding provide evidence of acceptable discriminant validity which following the recommendations of Hair, et al. [40] as well as Fornell and Larcker [45]. Furthermore, the CFA results demonstrated that the overall measurement model achieved a good fit with the observed data $\chi^2(74{,}626) = 264.33$, $P < 0.001$, CFL = 0.96, TLI = 0.94, SRMR = 0.04, RMSEA = 0.6 (90% CI = 0.056-0.073). This indicated that the adapted scales were appropriate for the Cambodian education setting.

Table 8. Item and Item Source of Constructivist Instructional Practices

Intitial Item		Final Item
Teacher autonomy support		
1. I encourage students to share their personal experiences and knowledge to support group learning.		I allow students to participate in decision-making about what they should learn.
2. I allow students to participate in decision-making about what they should learn.		I allow students to choose what to learn or work in groups.
3. I allow students to choose what to learn or work in groups.	6 ➔ 5	I allow students to choose homework assignments or research tasks based on their interests.
4. I allow students to choose homework assignments or research tasks based on their interests.		I provide a variety of research tasks so that students can choose any one of them.
5. I provide a variety of research tasks so that students can choose any one of them.		I take students' opinions into account when designing research tasks for them.
6. I take students' opinions into account when designing research tasks for them.		
Teacher support and feedback		
7. I create a classroom environment where students feel confident expressing their ideas and asking questions.		I create a classroom environment where students feel confident expressing their ideas and asking questions.
8. I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.	6 ➔ 5	I make time to provide guidance to students when they encounter difficulties related to lessons, homework or research tasks.
9. I check whether students understand the lesson before moving on to the next part.		I provide constructive feedback that have improve students' understanding of the lesson.
10. I provide constructive feedback that have improve students' understanding of the lesson.		I give useful feedback on students' homework or research assignments.
11. I give useful feedback on students' homework or research assignments.		I provide constructive feedback that helps enhance students overall learning.
12. I provide constructive feedback that helps enhance students overall learning.		

Support for cooperative learning		
13. I create opportunities for students to discuss idea with one another in groups.		I create opportunities for students to discuss idea with one another in groups.
14. I encourage students to try to understand the ideas of other students in their group.		I encourage students to try to understand the ideas of other students in their group.
15. I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.	6 ➔ 5	I create opportunities for students to teach or assist other group members when they experience difficulties with lessons, homework, or research tasks.
16. I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.		I encourage students to receive constructive feedback from other group members regarding lessons, homework, or research tasks.
17. I encourage students to collaborate with group members in preparing group-based research assignments.		I encourage students to collaborate with group members in preparing group-based research assignments.
18. I encourage students to take shared responsibility for the outcomes of group work.		

4.2. Discussion

This study aimed to develop and validate of an instrument designed to measure constructivist instructional practices (CIP) among high school teachers. Although previous research has explored constructivist teaching or constructivist pedagogy and proposed various measurement tools, these efforts have often been conducted in different educational levels or cultural contexts and have rarely provided comprehensive evidence of both reliability and validity within high school settings. Moreover, earlier studies have tended to focus either on specific dimensions of constructivist practice or on limited aspects of instrument validation, without simultaneously evaluating the factorial structure and psychometric properties of a unified scale. Given the limited availability of rigorously validated instruments tailored to high school contexts, this study sought to establish and test a multidimensional measure grounded in constructivist theory. While empirical investigations in this specific context remain relatively scare, the findings largely align with prior theoretical and empirical work on constructivist pedagogy.

The development and validation of the constructivist instructional practices instrument represent a significant step toward reliably measuring high school teachers' adoption of constructivist approaches in the Cambodian educational context. This study successfully refined an 18-item scales into a robust 15-item measures comprising three subscales (Teacher autonomy support 'TAS', Teacher support and feedback 'TSF', and cooperative learning 'CL'). Each subscale represented with the five items. The exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) results provided strong empirical evidence for the instrument's structural validity, internal consistency, and overall fit which aligned with established psychometric standards [40], [46]. Key finding from the EFA which conducted on a sample of 626 responses from teachers across 39 high schools in 11 provinces, revealed a five-factor solution initially accounting for 48.56% of variance. However, three items (TAS1, TSF3, and CL6) were removed due to run out of factor, cross, or negative loadings, which compromised their alignment with the intended constructs. TAS1 and CL6 exhibited diffuse loadings high across multiple factor, suggesting conceptual misalignment; and TSF3(-0.62) showed a negative loading and rub out of the factor, implying an inverse relationship that undermined validity [49]. After deletion, the refined 15-item scale demonstrated a clean three-factor structure with eigenvalues exceeding 1.0 and factor loadings ranging from 0.70 to 0.86, which supported the theoretical dimensions of constructivist practices. Item-level analyses further bolstered this, with Skewness and Kurtosis values largely within acceptable ranges (-0.67 to 1.61 and -2.00 to 1.44, respectively) which indicated normal distributions [46]. Corrected item-total correlations (-0.003-0.56) met or exceeded the 0.15 threshold, confirming each item's contribution to the overall scale [43], [47]. Internal consistency was adequate, with Cronbach's alpha of 0.82 for the full scale and above 0.84 for each subscale, met the ideal 0.80 benchmark, which may reflect the instrument's developmental stage or cultural nuances in response patterns.

The CFA which performed on a large independent sample (N = 626), affirmed the three-factor model with all standardized loadings exceeding 0.50 (ranging from 0.564 to 0.857) and highly significant ($P < 0.001$), demonstrating that the indicators reliably captured the latent constructs [40]. Composite reliability (CR) values

(0.82-0.89) and average extracted (AVE) (0.50-0.61) indicated strong convergence validity, while the square root of AVE (0.71-0.78) surpassed inter-construct correlations, and MSV (0.65-0.73) and ASV (0.003-0.055) were lower than AVE, confirming discriminant validity [45]. Model fit indices were satisfactory $\chi^2(74{,}626)$ = 264.33, $P < 0.001$, CFL = 0.96, TLI = 0.94, SRMR = 0.04, RMSEA = 0.6 (90% CI = 0.056-0.073), suggesting the CIP was well-suited to the Cambodian high school setting despite potential contextual influences such as resource constraints or traditional teaching norms.

These results extend prior research on constructivist instructional practices scale measurement by providing a context-specific tool for Cambodian teachers, where constructivism is increasingly emphasized in national reforms [50], [51]. The TAS subscale, focusing on student choice and opinion integration, aligned with autonomy supportive practices that fostered intrinsic motivation (e.g., TAS2: "I allow students to participate in decision-making about what they should learn). The TSF subscale emphasized guidance and feedback, crucial for scaffolding learning in resource limited environments. The cooperative learning subscale highlighted group collaboration, reflecting constructivism's social dimension. The removal of the items like CL6 ("I encourage students to take shared responsibility for the outcomes of group work") may indicated cultural factors, such as hierarchical classroom dynamics in Cambodia, where individual accountability predominated over collective responsibility, warranting further cross-culture investigation.

Practically, the validated CIP offered educators and policymakers a reliable means to assess and enhance constructivist practices, potentially improving student engagement and outcomes in high schools. Its brevity (15 items) and Likert scale format make it feasible for large-scale surveys. Theoretically, the findings reinforce constructivism's multidimensional nature, with autonomy, support, and cooperation as independent pillars.

5. CONCLUSION

This study successfully developed and validated from 18 initial items 15 final items constructivist instructional practices scale tailored for the Cambodian high school context. Through EFA and CFA, the instrument was refined from 18 items to a clear three-factor structure: Teacher Autonomy Support, Teacher Support and Feedback, and Cooperative Learning. Statistical results confirmed that the scale possesses robust factorial validity, satisfactory internal consistency, and strong convergent and discriminant validity, making it a reliable tool for assessing student-centered pedagogy.

Substantively, the scale captures the essential pillars of constructivist theory while highlighting the importance of cultural sensitivity in instrument development, particularly regarding how social norms influence collaborative learning. The validated constructivist instructional practices provide educators and policymakers with a feasible tool to monitor the implementation of learner-centered reforms and inform teacher professional development initiatives.

For future research, it is recommended that longitudinal studies be conducted to examine the predictive validity of the constructivist instructional practices scale in relation to long-term student academic outcomes. Additionally, further studies should test the instrument's generalizability in other Southeast Asian contexts and investigate test-retest reliability to ensure the stability of the measure over time.

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