Should it be $\exists\, x : P$ or $\exists\, x : P(x)$?

I often write $\forall\, x : P$, where P is an arbitrary formula that can contain x. To emphasize that P can contain x, I may instead write $\forall\, x : P(x)$. There is no significance to this difference when I'm discussing quantification in general. However, the exact formula $\forall\, x : P$ will never appear in a specification for the folllowing reason. Because $\forall\, x : P$ can be a legal TLA$^+$ formula only in a context in which x has no meaning, P cannot depend on x. (In particular, if P is a user-defined symbol, then x cannot appear in its definition.) Since P does not depend on x, the formula $\forall\, x : P$ is equivalent to P, so one would write simply P instead of $\forall\, x : P$. On the other hand, the exact formula $\forall\, x : P(x)$ could very well appear in a specification.

With obvious modifications, everything I just wrote applies as well to $\forall\, x \in S : P$ and with $\forall$ replaced by $\exists$. (Note that, if P does not depend on x, then $\forall x \in S : P$ equals $P \vee (S = \{\})$ rather than P.) I will never write $\forall x \in S(x) : P(x)$ because, in the formula $\forall x \in S : P$, the variable x may not appear in S.

CLOSE